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# Paydirt: a simulation of an industry of independent oil companies for use as an engineering-management aid.

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## A SIMULATION OF AN INDUSTRY OF INDEPENDENT OIL COMPANIES

## FOR USE AS AN ENGINEERING-MANAGEMENT AID

CHARLES E. BINGEMER

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# A SIMULATION OF AN INDUSTRY OF INDEPENDENT OIL COMPANIES FOR USE AS AN ENGINEERING-MANAGEMENT AID

by

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B.S., United States Naval Academy, 1960

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## ABSTRACT

This thesis is, in part, based upon the work of Lieutenant Commander Isidore L'Artique Tobin III, Supply Corps, United States Navy, as set forth in his thesis: "Management Games as an Academic and Military Instructional Device," University of Kansas, 1965. This computer programed simulation is a departure from the plans and flow charts as set forth in his thesis, but many of the ideas developed in his work were used in the preparation of this model. It would probably not have been possible to complete this model if his work had not already been available to draw upon.

Other very helpful information and experience was received from the study of and the participation in the IMAGINIT Management Game which is a creative business decision simulation developed by Dr. Richard F. Barton, Professor in the School of Business, University of Kansas.

## ACKNOWLEDGMENTS

The author wishes to sincerely thank Dr. Floyd W. Preston and Dr. Donald W. Green for their essential guidance and personal interest in this postgraduate educational experience and particularily in the preparation of this thesis.

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The author also wishes to note that participation in the Naval Postgraduate Educational Program has directly afforded him the opportunity to attempt to achieve the degree of Master of Science in Petroleum Management by fulfilling the requirements as set forth by the Faculty of the Graduate School, University of Kansas.

The final acknowledgment is to the author's wife for her vital interest, assistance, encouragement and understanding she has given during the course of instruction at the University of Kansas and in particular during the stressing period of the preparation of this thesis.

C. E. B.

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# CHAPTER I

# INTRODUCTION

## Background

The construction of any entity, whether it is a large building, a rocket or a literary work, should not commence until the necessary groundwork or foundation has been prepared. The groundwork for this thesis is begun by quoting a few definitions from the Funk and Wagnell Standard Dictionary of the English Language. The first definition is of the work "system" which is given as "an orderly combination or arrangement, as of parts or elements, into a whole; specifically, such combination according to some rational principle." The next definition is of the word "simulate: and is stated as "to assume or have the appearence or form of, without the reality." The last word, "model", is defined as "that which strikingly resembles something else; an approximate copy or image." One might then define the simulating or modeling of a system as the creating of another orderly arrangement of parts that gives the appearence or image of the simulated or modeled system. This would not mean that it is necessary for the model to be a physical replica, but it would mean that the new system should react or respond to the same stimuli in a manner similar to the one being modeled. To obtain this reaction or response is the crux of dynamic real life system simulation.

## Computer Program Model Building

Model building or simulation dates back before the days of the Egyptians.[1] Until World War II most models were rigid physical replicas normally on a smaller scale. During and after World War II it became possible to model dynamic systems of real life events without physical likenesses. This was brought about by the development of the high speed computer. The system to be simulated is modeled in mathematical equation form and, utilizing the theory of probability and random selection, events in a dynamic system can be simulated.

The computer utilizes the mathematical equations, together with added data, and processes a very large number of operations on them in a small amount of time. This permits the model to function over a long period of simulated time in a very short period of actual time. Reports of situation status or feedback can also be obtained and through analysis it can be determined in what manner the system model reacted to a certain stimulus. This technique is particularily useful during the building phase of the model.

## Use of Computer Program Models

Computer program models are basically used for two purposes. One purpose is to discover methods and means to improve a system and the other is to utilize the model for training personnel in becoming familiar with the system.[2] It should be kept in mind that the word system has been used in a broad sense.

## Purpose

This thesis is the result of an attempt to model a system which is an industry of independent oil companies. It is hoped that the

simulation will provide a tool for the training of students of Petroleum Engineering and of Petroleum Management in the areas of reservoir engineering and financial management. It is expected that the simulation will subject the student to a real life situation in which he will be required to analyze both engineering and financial data, make decisions based upon the results of his analysis, and live with the results that are reflected by the grades given by the model administrator. It is hoped that the use of this simulation will also stimulate the student's desire to obtain a more thorough knowledge of his speciality area than if the simulation had not been used. This stimulation might be accomplished by the gaming aspect of the model and the creation of a competitive atmosphere by the model administrator.

## Model Description

### General

The model is generally divided into three parts: lease ownership determination, lease development and production, and lease and company accounting. The first part, lease ownership determination, resolves which of the companies have purchased leases, which of the companies have sold leases and which of the companies have reverted or abandoned leases. The second part processes the development phase of a purchased lease as to drilling, fracturing, etc. and computes the production of oil and gas from each producing lease. The third part uses this output to calculate dollar amounts and performs the lease and company bookkeeping.

Beginning Procedure

To set the stage for the detailed description of the model as depicted in the following chapters, it is felt that a brief description of the beginning procedure would be appropriate.

As presently programed, the simulation allows a maximum of five participating companies. The students of a class are divided into a maximum of five groups with each group working together as a company. Each student is given a Student's Pamphlet which is outlined as part of Chapter V. The pamphlet contains a general description of the model, procedures to be followed, a list of decisions to be made, a set of lease descriptions, a set of engineering study descriptions and the format for the decision input cards. Each student is also given a list of the leases available for sale, an initial lease owner's report and an initial income statement and balance sheet. All companies start with the same amount of capital as indicated on the balance sheet. The amount of beginning capital is at the discretion of the model administrator.

It is necessary for the model administrator to assign various parameters to the control program. These parameters consist of the simulated period length, fines and penalties, interest on bonds and loans, and others. A list of these parameters with some recommended values are given in the Model Administrator's Pamphlet which is also outlined in Chapter V.

The program is written in FORTRAN IV computor program language and was initially modeled on an IBM 7040/7044 Operating System. The Fortran statements and the description of the variables used are set off from the

text by dashed lines for clarity. The text adjacent to the Fortran statements explains the reasoning used in writing the statements as they are written and explains their purpose in the program. The next three chapters are written in this detailed manner in order that individuals who would like to understand the program's calculations, as a model administrator or as a future developer of the program, may thoroughly understand the methodology and the rational utilized to build the model.

CHAPTER II

# LEASE OWNERSHIP DETERMINATION

## Lease Bidding

The first part of the programed model establishes the ownership of the leases. Establishing ownership is necessary before pursuing the development and production and the accounting parts of the simulation in order that each company's accounting can be carried out properly throughout the rest of the program.

### Competitive Bidding

The lease bidding simulation is processed as a closed bid competitive system of bidding that is common to real life bidding on property and contracts. Leases are offered for sale by the model administrator as indicated in the previous chapter. Companies are allowed a maximum of eight leases to bid on for each simulated time period.

Each company's bid is read from two input cards prepared by the company. Since this is closed bidding situation, bids of a company are not to be disclosed to other companies.

---

```
DO 130 I = 1,NPLAY
READ (5,11) (BID(I,J,1), J=1,8)
READ (5,11) (BID(I,J,2), J=1,8)
```

Where: NPLAY = number of companies participating
BID(I,J,1) = lease numbers of leases that bids are being made on
BID(I,J,2) = amount of money bid for the lease

---

On the first card all of the lease numbers of the leases to be bid upon are punched in the proper format. This format is given in the Student's Pamphlet which is part of Chapter V. On the second card are listed the amounts of money being offered as a bid for the corresponding leases on the first card.

Bids for Available Leases

The next operation for determining lease ownership is the picking of the first lease available for sale.

---

```
      IF (LEASE(II).GT.0) GO TO 200
  200 TEMP = LEASE(II)
```

Where: LEASE = array holding list of available leases
TEMP = a temporary holding space

---

If LEASE(II) contains a number other than zero, the number is the number of a lease that is available for sale. II will actually be the lease number that should be there if all leases are available for sale. The lease number is then converted to a floating point variable and stored in TEMP.

The program now checks each company's bids to determine if a company has bid and if the bid is on this particular available lease.

---

```
      DO 201 I = 1,NPLAY
      DO 202 J = 1,8
      IF (BID(I,J,1).LT.0.01) GO TO 202
      IF (BID(I,J,1).EQ.TEMP.AND.NCHECK.EQ.0) GO TO 224
      IF (BID(I,J,1).EQ.TEMP) GO TO 203
      GO TO 202
```

Where: NCHECK = a fixed point variable used to determine if the lease in question has been bid upon by a previous company during this simulation period

---

Determination of a Lease Buyer

If a company has not bid upon the lease, the program goes to the next company and repeats the procedure until all of the companies' bids have been checked. If one or more companies have bid on the lease, the first company's bid is detected by NCHECK = 0.

---

```
    224 IF (BIDMIN.GT.BID(I,J,2)) GO TO 201
        HOLD2 = BID(I,J,2)
        NEQUAL = 1
        IDENT(L) = I
        NCHECK = 1
        GO TO 202

Where:  HOLD 2   = a temporary holding space for the bid amount
                 = the number of equal bids on a particular lease if any occur
        IDENT(L) = array holding the identity of the companies making equal
                   bids
        BIDMIN   = the minimum acceptable bid set for the lease
```

---

The program checks to see if the bid amount is larger than the minimum bid acceptable for the lease if one is given. If the bid is less than the minimum bid, the bid is rejected and the program goes on to the next company. If it is greater than or equal to the minimum bid, the amount bid is stored in the temporary storage space called HOLD2, NEQUAL is set equal to one, the first storage space in the identification array is set equal to the company number making the bid, and NCHECK is set equal to one.

The program now proceeds to check the remaining companies' bids to determine if they have bid on the lease. If any other companies have, the program picks out the highest bid.

---

```
203 IF (BID(I,J,2).GT.HOLD2) GO TO 206
    IF (BID(I,J,2).NE.HOLD2) GO TO 201
    NEQUAL = NEQUAL + 11
    IDENT(NEQUAL) = I
    GO TO 201
```

---

The first statement tests to detect if the new bid is greater than the previous bid made on the lease in question. If it is, the previous bid is replaced by the new bid. The new bid is disregarded if it is less than the previous bid. If the new bid is equal to the previous bid, in the third statement one is added to NEQUAL to indicate that two companies have bid equally on the same lease and in the fourth statement the identity of the bidding company is stored in the next storage space of the identity array.

Once all of the bids have been checked, and only one company has bid the highest bid, the program proceeds to assign that lease to the company. If no bids have been made on the lease, the next available lease is selected and the process is repeated.

---

```
    IF (NEQUAL.EQ.1) GO TO 210
    IF (NEQUAL.EQ.0.AND.NDEAL.EQ.0) GO TO 189
    IF (NEQUAL.EQ.0.AND.NDEAL.EQ.1) GO TO 199
```

Where: NDEAL = an indicator to tell the program that a sale is being made between two companies

---

If there has been one or more bids on the lease, HOLD2 will hold the amount of the highest bid and the array IDENT will contain the identity of the company or companies making the highest bid.

When two or more companies have made equal bids that are the highest bids made, the winning company is selected by a random drawing.

---

```
    209 CALL RANDNO (RNUM)
        X = 0.0
        Z = NEQUAL
        Y = 1.0/Z
        T = Y
        DO 207 I = 1,NEQUAL
        IF (RNUM.GT.X.AND.RNUM.LT.Y) GO TO 208
        X = Y
        Y = Y + T
        IF (Y.GE.1.0) GO TO 209
    207 CONTINUE
    208 I = IDENT(I)
```

Where: RANDNO = a subroutine to generate evenly distributed random numbers between zero and one
- X = lower limit of each increment
- Y = upper limit of each increment
- T = the increment
- Z = transfers a fixed point variable to a floating point variable
- RNUM = the random number

---

A randon number is called from the subroutine RANDNO and is divided into as many equal parts or increments as there are equal bidding companies. The random number is compared to each increment and the increment in which the number falls will determine the winning company.

Now that the winning bidder has been established, the program proceeds to assign the company as lessee. It then removes the lease number from the list of available leases.

---

```
    212 LEESEE(I,J) = TEMP
        LEASE(II) = 0
```

Where: LESSEE(I,J) = an array that holds the identity of the leases that a company owns

---

The month of purchase is stored in the array NPDATE for future reference.

---

```
       NPDATE(II) = MESES + 1
       INTANG(II) = HOLD2 - TANG(II)

Where: HOLD2      = the original bid amount
       NPDATE(II) = the date of purchase
       INTANG(II) = the intangible assets
       TANG(II)   = the tangible assets assigned to the property
       MESES      = the total amount of time simulated
```

---

The intangible assets will be equal to the amount paid for the lease less the tangible assets, if any, which will have previously been assigned. It might be noted that lease characteristics are identified in the characteristic array by lease number whose value is stores as (II).

Selling of Leases by a Company

The companies are also allowed to sell leases to each other but not to the model administrator. The program first ferrets out a company desiring to sell a lease.

---

```
       DO 231 I = 1,NPLAY
       DO 232 J = 1,8
       IF (BID(I,J,1).LT.(-0.01)) GO TO 233
       GO TO 231
   233 II = -BID(I,J,1)

Where: II = number of the lease to be sold
```

---

When a company desires to sell a lease, a negative bid is made on the same card that normal bids for leases are made on. The minimum bid that is acceptable to the seller is punched into the second bid card

where normally the bid amount for leases sold by the administrator is punched. If a private deal is desired, the deal must be kept between the two parties involved in the deal as the program will recognize all bids on a lease. Bidding for leases that are for sale by companies, whether public or private, will be accomplished in the same manner as bidding for leases that are for sale by the model administrator.

The program next checks to insure that the company attempting to sell a lease actually owns it.

---

```
      DO 234 K = 1,MAXOWN
      IF (II.EQ.LESSEE(I,K) GO TO 235
  234 CONTINUE
      GO TO 236
      . . . . . . . . . . . . . . . . . . .
  236 PENSEL(I,2) = PENSEL(I,2) + FINE
      PENSEL(I,1) = -BID(I,J,1)

Where: MAXOWN      = the maximum number of leases a company may own
       PENSEL(I,1) = the number of the unowned lease a company is
                     attempting to sell
       PENSEL(I,2) = the total amount of selling fines for a company
       FINE        = the amount of penalty or fine
```

---

If a company does not own the lease it is attempting to sell, a fine will be imposed upon that company for making the attempt. This fine is a parameter set by the game administrator. A written notice will also be printed in the remarks section of the company balance sheet for that period.

Objective of Lease Bidding

Lease bidding is thought to be an important part of this model, because it is expected to spur the student to use his ability, or to acquire the ability to analyze both financial and engineering data.

It is necessary for the student to make a good analysis of the data in order that companies can make wise bids. Certainly a company may take a wild guess and have it turn out to be a good decision. It is thought, however, that such companies will lose their capital and go bankrupt.

The penalty or fine aspect of selling leases was included in an attempt to prevent the students from trying to foil the simulation by selling a lease they do not own, whether it might be for extra capital, or it might be to injure another company.

## Lease Reversion and Abandonment

At certain times and under certain circumstances oil companies may decide to give up a lease that they have purchased and can find no market for it. There are two other methods by which a company can dispose of an undersirable lease: reversion of the lease to the landowner or by properly abandoning the lease. Farmouts will be discussed later.

### Lease Reversion

An oil company might wish to revert a lease for any number of reasons. One reason might be that the company does not have sufficient funds or credit available to develop a lease within the lease period. It may then revert the lease to the landowner to reduce expenses. Another reason might be that the area around the lease has been tested with negative results which has reduced the chance that oil or gas may be found on the lease. The company may have brighter prospects for its capital and therefore decides not to invest in a development well.

In the program a company is allowed to revert a maximum of four leases per simulated time period. The lease number of the lease that is

to be reverted is punched in the proper field and read into the program.

---

```
       READ (5,11) (RVERSN(I,J), J=1,4),(ABAND(I,J), J=1,4)
       . . . . . . . . . . . . . . . . . . .
       DO 241 I = 1, NPLAY
       DO 241 J = 1,4
       IF (RVERSN(I,J).LT.0.01) GO TO 241
       II = RVERSN (I,J)
       IF (NWELLS(II,2).GT.0) GO TO 241
       DO 244 K = 1,MAXOWN
       IF (LESSEE(1,J).EQ.II) GO TO 245
   244 CONTINUE

Where: RVERSN(I,J)   = lease number of lease desired to be reverted
       NWELLS(II,2) = number of wells on the lease to be reverted
```

---

The program first checks the reversion entries of the companies. If a lease number is detected, ownership is checked to insure that the company attempting to revert the lease actually owns the lease. It then determines if there are wells on the lease. If there are, the request to revert is ignored, for the lease must be abandoned and not reverted. When there are no wells on the lease, and the requesting company owns the lease, the program reverts the lease to the model administrator without cost. The lease is then put back on the list of available leases for sale.

---

```
   245 LEASE(II) = II
       RVERSN(I,J) = 0.0
       LESSEE(I,K) = 0
```

---

If a company attempts to revert a lease that it does not own in an attempt to take advantage of the model or another company, the program ignors the request, fines the company, and prints out a note in the remarks section of the company's balance sheet.

---

```
    243 PENRVT(I,2) = PENRVT(I,2) + FINE
        PENRVT(I,1) = RVERSN(I,J)
        RVERSN(I,J) = 0.0

 Where: PENRVT(I,1) = the array holding the lease number attempted to
                      be reverted
        PENRVT(I,2) = the array holding the total amount of fines for
                      attempting to revert leases not owned
```

---

The fine is the same parameter as mentioned previously in the section on selling leases.

Lease Abandonment

Economic consideration is probably the main reason an oil company would desire to abandon a lease. Either the lease did not prove economically feasible during the development stage, or the lease has reached its limit of depletion from production. The difference between abandoning a lease and reverting a lease is that a lease with wells must be abandoned. The wells must be closed in and the property restored to its original condition, and the company must bare these costs. The lease being reverted has no wells or property damage and therefore no extra costs.

Each company is allowed to abandon a maximum of four leases per simulated time period. The lease numbers of the leases that are to be abandoned are punched into the lease abandonment request card beginning with the left most field. The abandonment entries are read in just after the reversion entries.

---

```
    READ (5,11) (RVERSN(I,J), J=1,4),(ABAND(I,J), J=1,4)
    . . . . . . . . . . . . . . . . . .
```

```
      DO 251 I = 1,NPLAY
      DO 252 J = 1,4
      IF (ABAND(I,J).LT.0.01) GO TO 251
      II = ABAND(I,J)
      DO 253 K = 1,MAXOWN
      IF (LESSEE(I,K).EQ.LL) GO TO 254
  253 CONTINUE
```

Where: ABAND(I,J) = the array holding the requests for lease abandonment

---

After the program checks through the request for abandonment entries and finds a lease number, it insures that the company requesting the abandonment of the lease actually owns the lease. If this checks, the program processes the abandonment request.

---

```
  254 ABDCOS(I,1) = II
      WELLS = NWELLS(II,2)
      ABDCOS(I,2) = ABDCOS(I,2) + WELLS * ABDNFT
```

Where: ABDCOS(I,1) = the array holding the lease numbers of the leases on which the abandonment costs occurred
ABDCOS(I,2) = the array holding the amount of abandonment costs
WELLS = a floating point variable used to transfer a fixed point variable to a floating point variable
ABDNFT = the amount charged per well upon abandonment

---

The number of the lease to be abandoned is stored in the array ABDCOS(I,1) and the abandonment costs for the lease are computed by multiplying the abandonment cost factor times the number of wells on the lease. The abandonment cost factor is a parameter assigned by the model administrator.

If it is determined that a company has attempted to abandon a lease it does not own, a fine is awarded similar to the fines described in the selling and reverting of leases.

---

```
        PENABD(I,1) = ABAND(I,J)
        PENABD(I,2) = PENABD(I,2) + FINE
        GO TO 251

 Where: PENABD(I,1) = the array holding the lease numbers of the leases
                      that have had abandonment attempted
        PENABD(I,2) = the array holding the amount of fines for attempting
                      to abandon leases not owned
```

---

First, the lease number upon which abandonment has been attempted is stored in the array PENABD(I,1). The fine is then awarded and the total amount is then stored in the array PENABD(I,2). FINE is the same parameter that was outlined in the section on selling leases.

Objective of Lease Reversion and Abandonment

Lease reversion and abandonment provides the companies with avenues to dispose of undesirable leases. It is expected that before a lease is reverted or abandoned, the student will analyze all available data in an attempt to determine if it is wise to give up the lease. This analysis should require the exercise of both his engineering and his financial management knowledge.

# CHAPTER III

# LEASE DEVELOPMENT AND PRODUCTION

## Labor

Almost all of industry must deal with organized labor in some manner. To achieve a bit more realizm in this industry simulation, the effects of labor contracts and negotiations have been included.

### Labor Contracts

It has been assumed for this simulation that all of the independent oil companies' labor forces have been unionized. The relationship between the company and the union is in either one of two states; either there is a contract in force or there is a period when negotiations are taking place.

When the company and the union have a contract in force, the company can not alter the wage rate.

---

```
IF (REQPAY(I).GT.1.1*PAYBAS) REQPAY(I) = 1.1 * PAYBAS
IF (REQPAY(I).LT.0.9*PAYBAS) REQPAY(I) = 0.9 * PAYBAS
IF (RLABOR.GT.0.1) REQPAY(I) = RLABOR
```

Where: RLABOR = the parameter to control whether or not a labor contract is in effect
PAYBAS = the parameter to control the basic wage rate
REQPAY(I) = the array that contains the companies' requests to change the labor wage rate

---

As shown in the third statement above, when the parameter RLABOR is set at some value greater than one tenth, the companies' requests to

change the wage rate are nullified by setting them equal to the amount set in RLABOR. RLABOR is a parameter set by the model administrator and can be used to vary the sensitivity of the strike feature of the simulation. If an amount greater than PAYBAS is set into RLABOR, the sensitivity of the strike feature is decreased. If the amount is less, the sensitivity is increased. PAYBAS is another parameter set by the model administrator at the initial starting point of the simulation and it is not changed.

A contract period is terminated and a negotiating period commences when the model administrator sets RLABOR equal to zero. The companies may then adjust their labor wage rate within ten per cent of the amount set in PAYBAS. If they attempt to set it higher or lower, the program will automatically assign it back to its related limit. By lowering the wage rate below the base rate, a company will increase the probability that it will have a strike. If it increases the wage rate above the base rate, the probability of a strike will decrease.

The status of a labor contract, in effect or not in effect, pertains to the whole industry and cannot be set for individual companies as the model is presently programed.

## Fringe Benefits

Another aspect of reality concerning the management - labor relationship is the payment of fringe benefits. These fringe benefits may be payment of a certain sum into a retirement fund, payment of medical insurance premiums, or other similar items. In this simulation, fringe benefits are not frozen by a labor contract but they may be varied up or down at any time.

```
IF (BENFIT.GT.0.01) FRINGE(I) = BENFIT
. . . . . . . . . . . . . . . . . . . . .
IF (FRINGE(I).GT.2.0*BENBAS) FRINGE(I) = 2.0 * BENBAS
```

Where: BENFIT = a parameter to control the fringe benefit feature
FRINGE(I) = array holding the companies' requests to change fringe benefits
BENBAS = a parameter to set the base benefit rate

The parameter BENFIT, set by the model administrator, may be in a similar manner as the parameter RLABOR was used for labor wages. If BENFIT is set equal to zero, the companies will be allowed to vary the payment of fringe benefits to its employees. The variation is limited to a minimum of zero and a maximum of twice the parameter BENBAS which is the basic fringe benefit rate set at the initial starting point by the model administrator. If BENFIT is set equal to the same amount as BENBAS, fringe benefits will have no effect upon the likelihood of the company taking a strike. As with RLABOR, if BENFIT is set lower than BENBAS, the probability of a strike will increase. If it is set higher, the probability will decrease.

The effect of the variation of BENFIT upon the ability to vary fringe benefits or upon the sensitivity of a strike will be felt industry wide and cannot be set for individual companies as the model is presently programed.

## Labor Strikes and Their Effects

Before development of the leases can be performed or the production of oil and gas can be accomplished, it must be determined if the

labor is available to carry out these tasks. If the labor unions have called a strike, no development or production will occur for a maximum of two months. If the simulated period length is less than two months the strike will last for only the period length.

---

```
       IF (ISTRIK.EQ.1.AND.JJ.LT.3) GO TO 632

Where: ISTRIK = is an integer variable representing the variable STRIKE
       JJ     = the month number of the simulated period presently being
                run
```

---

If a strike should occur, ISTRIK will equal one and the program merely bypasses the drilling and development routines.

A strike will or will not occur depending upon the probability of a strike and random selection. The probability of a strike is computed by the comparison of the relative amounts of wages and fringe benefits that are being paid to the company's employees.

First, it is necessary to compute the average wage and the average fringe benefits paid in the industry.

---

```
       DO 300 I = 1,NPLAY
       IF (REQPAY(I).GT.0.1) PAY(I) = REQPAY(I)
       IF (FRINGE(I).GT.0.01) EMPBEN(I) = FRINGE(I)
       TEMP = TEMP + PAY(I)
       . . . . . . . . . . . . . . . . . . . . . . . . . .
   300 HOLD2 = HOLD2 + EMBBEN(I)
       X = NPLAY
       PAYAVG = TEMP/X
       BENAVG = HOLD2/X

Where: TEMP      = a temporary holding variable
       HOLD2     = a temporary holding variable
       PAY(K)    = the wage rate to be in force for this time period
       EMPBEN(I) = the fringe benefit rate to be in for this time
                   period
```

```
PAYAVG    = the average employee wage rate for the industry
BENAVG    = the average fringe benefit rate for the industry
X         = changes a fixed point amount to a floating point
```

---

In the second and third statements above, the new wage rates and new fringe benefit rates are set for the simulated period. If there is no change, the program will use the rate from the previous period which will have been stored in the arrays PAY(I) and EMPBEN(I).

In computing the strike probability, which is represented by the variable STRIKE, the program first compares the wage and benefit rates with their respective industry averages.

---

```
      STRIKE = (1.0 - PAY(I)/PAYAVG) + (1.0 - PAY(I)/PAYBAS)
      STRIK2 = (1.0 - EMPBEN(I)/BENAVG) + (1.0 - EMPBEN(I)/BENBAS)
      STRIKE = (STRIKE + STRIK2) * STKFAC
      IF (STRIKE.LT.0.0) STRIKE = 0.0
      IF (STRIKE.GT.1.0) STRIKE = 1.0

Where: STRIKE = a variable holding the probability of a strike
       STRIK2 = a temporary holding variable
       STKFAC = a factor to control the sensitivity of the strike
                probability
```

---

The first and second statements above shows that if a company's wage rate and fringe benefit rate are equal to both of the respective averages and bases, a strike probability will not be generated. It can be easily seen that if one company pays high wages and low benefits and another company pays low wages and high benefits, the resulting strike factors may be equal. It can also be seen that companies that pay both low wages and fringe benefits will greatly increase their chances of getting a strike. STKFAC is a parameter set in by the model administrator

to control the sensitivity of the strike factor or, if it is set equal to zero, the strike feature will be completely eliminated from the model.

Although the variable STRIKE is greater than zero, it does not mean that a strike will occur.

---

```
CALL RANDNO (RNUM)
IF (RNUM.GT.0.0.AND.RNUM.LT.STRIKE) STRIKE = 1.0
IF (STRIKE.EQ.1.0) GO TO 630
```

---

The determination of the strike status by random number attempts to take the human element into account in the simulation. Even if the STRIKE is a high number, nine-tenths for example, a random number larger than STRIKE would keep a strike from being called. To relate this to real life it would mean that a company might have a high probability of a strike because of low wages and inadequate fringe benefits being paid to its employees, but because the employees have other interest in the company, they do not want to strike.

## Lease Development

The simulation of the development of different types of reservoirs would take on mammoth proportions if all of the factors describing the reservoir and its contents were taken into consideration and made compatible. This would be beyond the scope of this thesis, therefore a simplified approach was taken. Equations were selected and experimented with until they would produce approximately the traits desired. Limits were set and in many cases random selection decided the reservoir and well conditions. This method was used to generate various reservoir and well

characteristics such as initial well pressure, recoverable reserves, initial flow rates, etc.

Once the initial wells have been drilled and the lease development wells have been completed, it may be desirable to treat the wells. Two well treatments are provided in this simulation: fracturing and acid treating. The procedure followed produces results that approximate the real life event.

After the wells of a lease have stopped flowing by natural forces, it may be desirable to install pumps on the wells. This event is also simulated in the program. If the pumps do not produce the desired results or the wells have declined below the economical limit for pumping, a secondary recovery system may be installed on the lease upon request.

One departure from reality has been made for the cause of programing simplicity. If it is desired to fracture, acid treat, install pumps, or install a secondary recovery system on a lease, it will be done on all of the wells of the lease. Overall lease performance must be used to decide whether or not to invest in one of these improvements.

Exploratory Drilling

Exploratory wells may be drilled on a lease whenever requested by the company who owns the lease. In this work, an exploratory well is the initial well drilled on the lease where there are no other producing wells. If an exploratory well is not drilled on an unproven lease within one year of purchase, a delay rental rate will automatically be charged at the amount of one dollar per acre per year as stated in the lease descriptions.

Companies are permitted to drill on a maximum of eight leases for each simulated time period. The company decisions as to which lease they

desire to drill on and how many wells are to be drilled are read into the computor.

---

```
READ (5,25) (XDRILL(I,J,1), J = 1,8)
READ (5,25) (XDRILL(I,J,2), j = 1,8)

Where: XDRILL(I,J,1) = the array that holds the lease numbers upon which
                       drilling is desired
       XDRILL(I,J,2) = the array that holds the number wells desired to
                       be drilled
```

---

Limitations have been set in the model which allow only one exploratory well to be drilled per month and four development wells to be drilled per month thereafter on the same lease. It was felt that if oil or gas was found on the lease, more rigs would be moved in to develop the reservoir as fast as possible.

When the computor reaches the development portion of the program, it checks to determine if a request to drill has been made and if the well to be drilled is an exploratory well.

---

```
      DO 650 K = 1,8
      IF (XDRILL(I,K,1).EQ.TEMP.AND.NWELLS(II).EQ.0) GO TO 658
      . . . . . . . . .
  650 CONTINUE
      . . . . . . . . .
  658 KOUNT = KOUNT + 1
      IF (KOUNT.EQ.1) WRITE 96,1100) I
      IF (JJ.EQ.1) WRITE (6,1101) II

Where: TEMP        = the lease number as a floating point variable
       NWELLS(II)  = the number of producing wells on the lease
       KOUNT       = an integer counting variable
```

---

The last three statements above are merely statements to control the format of the Lease Development Report.

The next task to be accomplished is to determine if there is oil and/or gas under the lease being drilled upon. All unproven lease descriptions were analyzed and have been assigned a geological chance or probability of discovery factor the value of which ranges from zero to one. The term "geological chance" has been defined as the chance of finding oil on any exploration attempt.[3] First, the requested number of wells must be reduced by the initial well.

---

```
      XDRILL(I,K,2) = XDRILL(I,K,2) - 1.0
      CALL RANDNO (RNUM)
      IF (RNUM.GT.GEOFAC(II)) GO TO 659
      GO TO 660

 Where: RNUM      = a random number between zero and one
        GEOFAC(II) = the geological chance of discovery for the lease
```

---

A random number represented by the variable RNUM is called from the subroutine RANDNO. It is then compared with the geological chance factor. If the random number is greater than the geological chance factor, a dry hole has been drilled.

---

```
  659 GEOFAC(II) = 0.0
      HOLD2 = 0.0
      IF (NWELLS(II).EQ.0) K = 1
      WRITE (6,1103) JJ, K, DRY, HOLD2
      . . . . . . . .
      XDRILL(I,K,1) = 0.0
      XDRILL(I,K,2) = 0.0

 Where: HOLD2 = a temporary variable representing the initial well flow rate
        JJ    = the month number of this simulated period in which the well
                was drilled
        K     = the number of the well drilled this month
```

---

The assumption has been made in this model that when a dry hole is drilled on a lease, all other wells drilled on the lease will be dry. This

is the reason why the geological chance factor is set equal to zero. The company who owns the lease may drill again the next period, but the result will again be a dry hole. Each time a well is drilled, a statement is printed on the Lease Development Report that includes the month of the simulated period during which the well was drilled, the well number for that month, the status of the well (whether it is a discovery well or a dry hole), and the initial flow rate of the well. Further information is provided if the well is a discovery well and will be explained later. If the well is a dry hole, no more wells will be drilled on the lease for the period in which the dry hole was drilled even though more wells were requested. The program will proceed to the next lease of the company.

A well is a discovery well if the random number drawn is less than or equal to the geological chance factor. When it is a discovery well, the amount of recoverable oil in the reservoir discovered is determined by a random selection process. The method utilizes a distribution of the per cent chance of average field size as set forth by F. A. Lanee in his article "How Many Fields Really Pay Off?"[4] and graphically illustrated by Campbell and Schuh in their paper "Risk Analysis" Overall Chance of Success Related to the Number of Ventures."[5] The per cent chance of field size was divided into nine equal increments and a random number is used to determine the catagory of the field size to represent the discovery.

---

```
660 X = 0.0
    W = 0.0
    CALL RANDNO (RNUM)
    DO 661 K = 1,9
    W = W + FLOAT(K)
    Y = W/45.
```

```
      IF (RNUM.GT.X.AND.RNUM.LE.Y) GO TO 662
  661 X = Y

Where: X = the lower limit of the increment
       Y = the upper limit of the increment
       W = a temporary holding variable
```

---

The limits of the field sizes were picked corresponding to the per cent chance limits. Although Lanee's distribution plots as a curve on regular coordinates, linear interpolation is used to calculate the field size that lies between the limits of the increment. It was felt that the results obtained would be accurate enough for this purpose.

The calculations for the nine catagories of reservoir size are similar except for the numerical values, therefore only the catagory for the increment of between ten and twenty per cent chance is discussed.

---

```
  662 CALL RANDNO (RNUM)
      GO TO (663,664,665,666,667,668,669,670,671), K
      . . . . . . . . .
  664 RESORS(II) = (263. + RNUM * 560) - 10000.
      LESFAC(II) = RESORS(II) * .000002
      DZERO(II)  = 0.034167
      QZERO(II)  = 1./.000006 - DZERO(II)/.995
      PINT(II)   = 1000. + RNUM * 4000.
      FVF(II)    = 1.1 + RNUM * 0.4
      GO TO 675

Where: RESORS(II) = the total recoverable oil on the lease
       LESFAC(II) = the factor that limits the number of wells on the lease
       DZERO(II)  = the slope of the production decline curve
       QZERO(II)  = the initial well flow rate potential in barrels per day
       PINT(II)   = the initial reservoir pressure
       FVF(II)    = the initial formation volume factor
```

---

The first number in the first statement above which calculates the amount of recoverable oil is the limit for the minimum amount of recoverable

oil in the reservoir. The second number is the increment between the minimum amount and the maximum amount.

The lease factor is utilized to determine the maximum number of wells that can be drilled on the lease. As will be shown later, a well factor between zero and one will be assigned to each well drilled on the lease, and will determine the production rate of the well. As the well factors are assigned, their values are subtracted from the lease factor. All wells drilled after the lease factor is reduced to zero will be dry holes. This procedure was used in preference to using various well spacing and location on certain size leases because of its comparative simplicity.

The slope of the decline curve represented by DZERO(II) was chosen by experimental means. How it was chosen will be explained later in the section on lease production of this chapter.

The initial flow rate potential, or QZERO(II), is the term used to describe the best possible flow rate per well for the reservoir. The equation used to calculate QZERO(II) was derived by integrating the equation to describe the decline of the recoverable reserves between the initial flow rate and a low flow rate limit and resulted in:

$$Q_o = \frac{(\text{RESERVES})(D_o)}{1. - \text{FACTOR}}$$

Where: $Q_o$ = the initial flow rate
RESERVES = the recoverable reserves
$D_o$ = the slope of the production decline curve
FACTOR = a number chosen that when multiplied by $Q_o$ established the low flow limit

The derivation of this equation is given in APPENDIX E.

To find the maximum recoverable oil for a well with a well factor of one which is the maximum flow potential, the total amount of recoverable oil is divided by the lease factor. If this answer is used, the total recoverable oil would be recovered when the flow rate declined to the low limit previously set by multiplying the amount FACTOR times the initial flow rate. It is desired, however, that about half of the recoverable oil be recovered by natural forces with the rest left to be recovered by artificial lifting methods and secondary recovery. Therefore, the quotient of the reserves divided by the lease factor is now divided by two. The result is multiplied by DZERO(II) and divided by one minus FACTOR to obtain QZERO(II).

Initial reservoir pressure is not directly related to the well flow rate or the amount of recoverable reserves. It is more a function of depth or the reservoir's natural surroundings, and therefore is picked by a random process. The limits of reservoir pressure are set at 1000 PSI to 5000 PSI and the process chooses some pressure in between the two.

The initial formation volume factor is selected by the same random process between the limits of 1.1 and 1.5. Since the formation volume factor is related to the initial pressure, it is related to the initial pressure by using the same random number to calculate it.

The next step is to assign the well a number and a well factor and compute the initial flow rate of the well.

---

```
675 CALL RANDNO (RNUM)
    WELNUM(LASTNM,1) = II
    WELNUM(LASTNM,2) = RNUM
    LASTNM = LASTNM + 1
    LESFAC(II) = LESFAC(II) - RNUM
    HOLD2  = QZERO(II) * RNUM
```

```
Where: WELNUM(LASTNM,1) = the array holding the lease number in which the
                          well is located
       WELNUM(LASTNM,2) = the array holding the well factor
       LASTNM           = the index of the well number array which is
                          actually the well number
       HOLD2            = a temporary holding variable that represents
                          the initial flow rate of the well
```

---

First, a random number is called and is used as the well factor. The well is then assigned its lease number in the first column of the WELNUM array, and the well factor is assigned to the corresponding location in the second column of the array. One is then added to the variable LASTNM in order that the next number will be ready for the next well completed.

The last characteristics of the well and oil are now calculated.

---

```
OILFAC = (HOLD2 - HOLD2/EXP(DZERO(II)))/2.0
PI = OILFAC/((PINT(II) - PINT(II)/EXP(DZERO(II) * 1.4))/2.0)
CALL RANDNO (RNUM)
VISCTY(II) = 0.1 + 20. * RNUM
CALL RANDNO (RNUM)
GORINT(II) = 1000. * RNUM
NWELLS(II) = NWELLS(II) + 1

Where: VISCTY(II) = the oil viscosity for the reservoir in centipoise
       GORINT(II) = the initial producing gas-oil ratio
       OILFAC     = the average flow rate in barrels per day over a
                    period of one month
       PI         = the productivity index for the well
```

---

In the first statement, the average oil flow rate is determined for the first month of production by calculating the rate at time zero and the rate at time one and averaging the two values.

PI, the productivity index, is defined as "the ratio of the rate of production, expressed in stock tank barrels per day, to the pressure drawdown at the midpoint of the producing interval."[6] It is used to indicate the producing ability of the well.

The next four statements determine the viscosity of the oil in centipoise and the producing gas-oil ratio. Both values are picked by utilizing random numbers to select a value between set limits. Since this is the initial well for the lease, the last statement establishes the number of producing wells contained in the array NWELLS for the lease as one.

All reservoir, well, and oil characteristics calculated are printed on the Lease Development Report for the initial well on the lease. For all development wells after the initial well, all of the characteristics are printed except the formation volume factor and the viscosity which will be the same for all wells on the lease.

## Development Drilling

Once a discovery well has been completed, the drilling of the development wells can begin. The number of the development wells drilled is limited to four wells per month per lease. The requests for drilling are checked to determine if the company desires to drill on its lease.

---

```
      DO 650 K = 1,8
      . . . . . . . . .
      IF (XDRILL(I,K,1).EQ.TEMP.AND.XDRILL(I,K,2).GT.0.1) GO TO 651
  650 CONTINUE
      . . . . . . . . .
  651 KOUNT = KOUNT + 1
      . . . . . . . . .
      IF (XDRILL(I,K,2).GT.4.0) GO TO 634
      N = XDRILL(I,K,2)
      XDRILL(I,K,2) = 0.0
      GO TO 635
  634 N = 4
      XDRILL(I,K,2) = XDRILL(I,K,2) - 4.0
  635 CONTINUE
```

Where: N = the number of wells to be drilled this month

---

When the program discovers that development wells are to be drilled, it tests to see if the number of wells requested to be drilled is greater than four. If it is less than four, the number requested is reduced to zero and the wells are drilled. As previously stated, the maximum number of wells to be drilled per month is limited to four. If the number of wells requested to be drilled is greater than four, the alloted four wells are drilled and the remaining wells will be drilled the following month if circumstances permit.

---

```
      DO 652 K = 1,N
      CALL RANDNO (RNUM)
      IF (LESFAC(II).LT.0.001) GO TO 659
      IF (LESFAC(II)-RNUM.LE.0.0) RNUM = LESFAC(II)
      WELNUM(LASTNM,1) = II
      WELNUM(LASTNM,2) = RNUM
      LESFAC(II) = LESFAC(II) - RNUM
      NWELLS(II) = NWELLS(II) + 1
      HOLD2 = RNUM * QZERO(II)
      . . . . . . . . .
  652 CONTINUE
```

---

The procedure is similar to the procedure used for the discovery well with the exception of the third and fourth statements. The third statement tests to find out if the limit of the number of wells for the lease has been reached. If it has, the well drilled will be a dry hole and no more wells will be drilled on the lease for the remaining part of the simulated time period. The fourth statement tests the random number to determine if it is larger than the remaining amount stored in the lease factor for the reservoir. If the random number is larger, it is set equal to the lease factor. This prevents the sum total of the well factors from becoming greater than the original lease factor.

Development drilling will continue as long as it is requested at the rate of four wells per month until the lease factor is reduced to zero.

<u>Well Treating, Artificial Lifting, and Secondary Recovery</u>

Well treating in the model includes well fracturing and acid treating. Companies may have the wells fractured on a maximum of four leases and the wells acid treated on a maximum of four leases during a simulated time period. The lease numbers of the leases on which the company desires to have the wells fractured or acid treated are read into the computor.

---

```
      READ (5,25) (REQFRC(I,J), J = 1,4),(REQACD(I,J), J = 1,4)

Where: REQFRC(I,J) = the array holding the identity of the leases
                     requested to be fractured
       REQFRC(I,J) = the array holding the identity of the leases
                     requested to be acid treated
```

---

Before the production of gas and oil on a lease is calculated, the request arrays for fracturing and acid treating are checked to find out if the wells on the lease are to be fractured or acid treated.

---

```
      DO 648 k = 1,4
      IF (REQFRC(I,K).EQ.TEMP) GO TO 633
      IF (REQACD(I,K).EQ.TEMP) GO TO 633
      . . . . . . . .
  648 CONTINUE

Where: TEMP = a temporary floating point variable holding the lease
              number in question
```

---

If a request for fracturing or acid treating is made, there will be no production on the lease for that month of the simulated period. Drilling is done, however, for fracturing and acid treating may be thought of as an extension of the well completion routine.

Once the production calculations are bypassed and any requested drilling is completed, the request arrays are again checked.

---

```
676 X = NWELLS(II)
    DO 677 K = 1,4
    IF (REQFRC(I,K).EQ.TEMP) GO TO 685
    IF (REQACD(I,K).EQ.TEMP) GO TO 686
677 CONTINUE
    GO TO 632
```

---

If there are no requests to fracture or acid treat the wells on the lease, the program proceeds either to the next month of the simulated period or to the lease accounting section.

When there is a request for the wells of a lease to be fractured, whether or not the fracture treatment is successful is next determined.

---

```
685 REQFRC(I,K) = 0.0
    IF (NO(II).NE.30.OR.NO(II).NE.40) GO TO 687
    NO(II) = NO(II) - 5
    CALL RANDNO (RNUM)
    IF (RNUM.LT.FRCFAC) GO TO 687
```

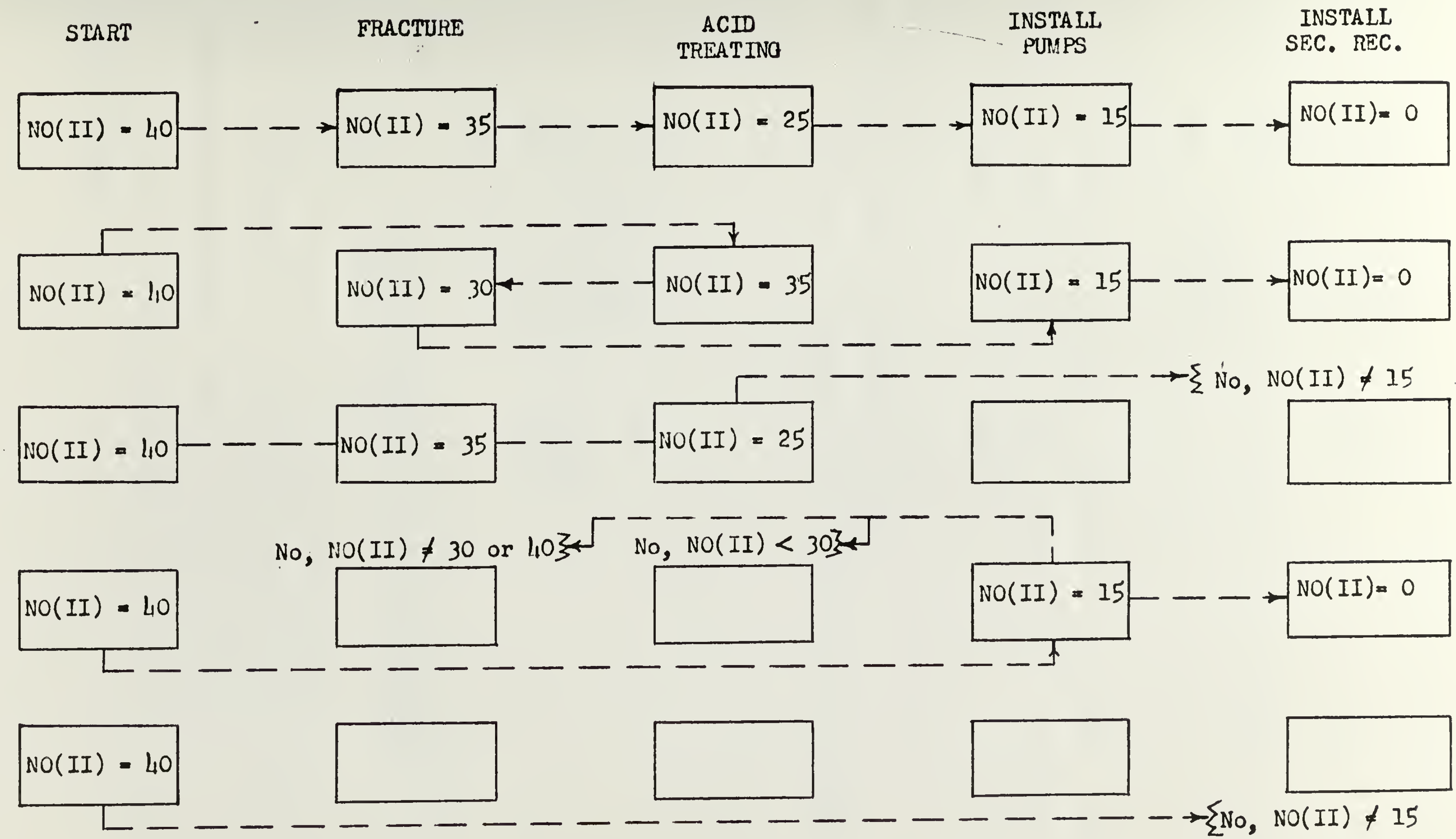
Where: FRCFAC = parametric variable representing the chance that the fracture treatment is not effective
NO(II) = the control array for well treating, pumping and secondary recovery

---

The control array given above as NO(II) is used to control the number of times well treatments, installation of pumps, and installation

of secondary recovery can be carried out on a lease, and the order in which they are carried out. It limits each lease to one fracture treatment and one acid treatment per well. Each time the attempt is made to fracture or acid treat a well after the initial attempt, the treatment will not effect the wells production rate but the company will lose one month's production from the lease. Fracturing and acid treating the wells of a lease can be performed in any order, however, they may not be done once pumps and/or secondary recovery systems have been installed on the lease. The control array also limits a company from installing a secondary recovery system on a lease before the company installs pumps. If a lease is sold to another company, the purchasing company must abide by the conditions of the lease, i.e. if a well has been fractured it cannot be fractured again. The diagram on the following page illustrates the control array's operation.

A random number is called from the subroutine and compared with the parameter FRCFAC which is the per cent chance in decimal form that the fracture of the well will not effect the well's production. The value for FRCFAC is set in by the model administrator at the beginning of the simulation. If the random number is less than the value stored in FRCFAC, the program bypasses the fracturing routine, charges the company for the fracture treatment of one well, and prints a statement on the Lease Development Report reporting the results. If the random number is greater than FRCFAC, the program proceeds to adjust the initial well flow rate and the slope of the decline curve to simulate the effects of a successful fracture treatment.




The diagram of the array, NO(II), which shows how the array controls a company's actions in well fracturing, acid treating, installing pumps, and installing secondary recovery.

---

```
       QZERO(II) = QZERO(II) * FRFLOW
       DZERO(II) = DZERO(II) * DECLN
       . . . . . . . . .
       WRITE (6,1105) X, Z

 Where: FRFLOW = a number greater than one used to increase the initial
                 flow rate
        DECLN  = a number used to increase or decrease the decline rate
```

---

The parameters FRFLOW and DECLN are set by the model administrator before the simulation begins. If it is thought that the effects on the production quantity and on the production decline are not proper, the values of the parameters may be changed by locating them in the carry-over deck and making the proper adjustments.

The next well treatment is acid treating and it is handled similar to the fracture treating routine.

---

```
   686 REQACD(I,K) = 0.0
       IF (NO(II).LE.30) GO TO 688
       CALL RANDNO (RNUM)
       IF (RNUM.LT.ACDFAC) GO TO 688
       QZERO(II) = QZERO(II) * ACFLOW
       DZERO(II) = DZERO(II) * DECLN
       . . . . . . . . .
       WRITE (6,1107) X, Z

 Where: ACDFAC = the parametric variable representing the chance that
                 the acid treatment will not be successful
        ACFLOW = similar to FRFLOW
```

---

The adjustments to the initial flow rate and the slope of the decline curve are similar to that of the fracture treatment. They are set in the initial starting deck to make acid treating less effective than fracturing.

The next operation that might be performed on the lease is the installation of pumps.

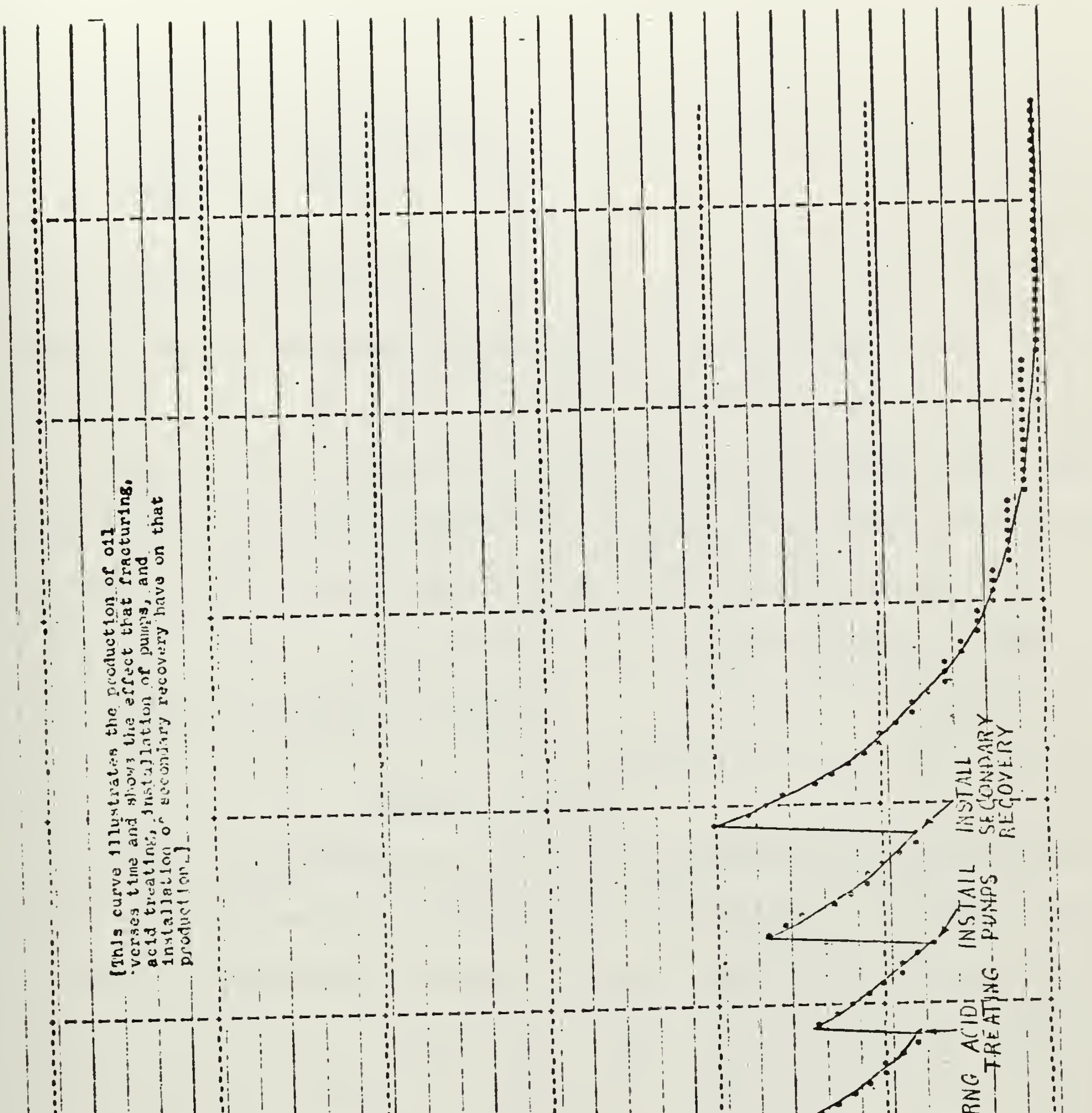
---

```
      READ (5,25) (REQPMP(I,J),J = 1,4), (REQSEC(I,J),J = 1,4)
      DO 648 K = 1,4
      . . . . . . . . .
      IF (REQPMP(I,K).EQ.TEMP) GO TO 690
      IF (REQSEC(I,K).EQ.TEMP) GO TO 691
  648 CONTINUE
      . . . . . . . . .
  690 REQPMP(I,K) = 0.0
      IF (OILFAC.GE.OILALW) GO TO 632
      IF (NO(II).LE.15) GO TO 632
      QZERO(II) = QZERO(II) * PMFLOW
      DZERO(II) = DZERO(II) * DECLN
      NO(II) = 15
      VCFACT(II) = VCFACT(II) * 1.2
```

```
Where: REQPMP(I,K) = the array holding the number of the leases upon
                     which pumps are requested to be installed
       REQSEC(I,K) = the array holding the numbers of the leases upon
                     which secondary recovery systems are requested
                     to be installed
       OILALW      = a parameter holding the allowed monthly production
                     rate of oil
       PMFLOW      = similar to FRFLOW and ACFLOW
       VCFACT(II)  = the variable cost factor used to claculate lease
                     operating costs
```

---

The installation of pumps on a lease is handled in a manner similar to that of fracturing and well treating with a few exceptions. It was felt that the chance of failing to produce results by pumping was small and the chance of failure has been ignored. Since additional equipment maintenance and operating costs will occur with the installation of pumps, the variable cost factor that is used to compute operating costs for the lease is increased. Also, companies are restricted from going into this phase of production as well as the secondary recovery phase that follows until flow rates from the wells drop below the allowed oil production rates.




[This curve illustrates the production of oil verses time and shows the effect that fracturing, acid treating, installation of pumps, and installation of secondary recovery have on that production.]

The last phase that production on a lease may enter is the secondary recovery phase.

---

```
691 REQSEC(I,K) = 0.0
    IF (OILFAC.GE.OILALW) GO TO 632
    IF (NO(II).EQ.0) GO TO 632
    QZERO(II) = QZERO(II) * SRFLOW
    DZERO(II) = DZERO(II) * .9
    . . . . . . . . .
    NO(II) = 0
    VCFACT(II) = VCFACT * 1.3
```

Where: SRFLOW = a parameter similar to FRFLOW, and PMFLOW

---

The secondary recovery is also similar to the pumping phase. The installation and equipment maintenance costs are greater than with just the pumps and are simulated by using a larger factor multiplied times the variable cost factor. The installation costs will be discussed further in the section on company accounting.

## Lease Production

Much of the simulation of the lease development and production is based upon the generation of production decline curves. It has been stated that there are basically two classes of decline curves that describe the production rate decline of reservoirs. These two classes are the hyperbolic and the exponential curves.[7] Of the two, the exponential class was chosen to be used in this model because it was simple to work with and it produced the desired results.

The formula given to describe the exponential decline curve is:

$$q_t = q_o e^{-Dt}$$

Where: $q_t$ = the oil production rate at time t
$q_o$ = the initial oil production rate
$D$ = the slope of the decline curve

See Appendix E for the derivation of the equation.

The value of the slope, D, was picked experimentally for each catagory of reservoir previously mentioned in order that the initial flow rate and the amount produced would be within reasonable limits. From the equation above and from the equation given previously for calculating the initial flow rate of the wells, it can be seen that when the slope, D, multiplied by the value for time equals one, about thirty-seven per cent of the reserves, producible by natural forces, have been produced. Also, the flow rate at that time is thrity-seven per cent of the initial well flow rate.

The program first calculates an average oil production factor which would be the production from a well for the month if its well factor was equal to one.

---

```
OIL1 = QZERO(II)/EXP(DZERO(II) * TIME(II))
OIL2 = QZERO(II)/EXP(DZERO(II) * (TIME(II) + 1.0))
OILFAC = (OIL1 + OIL2)/2.0
```

Where: OIL1 = the production rate at the beginning of the first month
OIL2 = the production rate at the beginning of the next month

---

The production rate for the first of the month is calculated and averaged with the production rate calculated for the next month. Although the line between the two points is a curve and an average assumes it to be a straight line, the two points are close enough to give a good approximation of the average production for the month.

Next, the program generates an average producing gas-oil ratio or GOR for the month.

---

```
      GFAC = GORINT(II)/10.
      GOR1 = (1. + SIN(3.141659 * (3./2. + TIME(II)/GFAC))) * QZERO(II)
     1 * 30./DZERO(II))/OIL1 + GORINT(II)
      GOR2 = (1. + SIN(3.141659 * (3./2. + (TIMES(II) + 1.0)/GFAC)))*
     1 QZERO(II) *  30./DZERO(II)/OIL2 + GORINT(II)
      GOR  = (GOR1 + GOR2)/2.0
      IF (GOR.LT.GORINT(II)*0.9) GOR = GORINT(II) * 0.9
```

Where: GOR1 = the gas-oil ratio at the beginning of the month
GOR2 = the gas-oil ratio at the end of the month
GOR = the average gas-oil ratio for the month
GFAC = a factor used to vary the peak of the gas-oil ratio curve

---

The equation for the producing gas-oil ratio was determined experimentally and is based on a skewed sine curve with time zero starting at the minus one point on the curve. The resulting curve is similar to the producing gas-oil ratio curve that might be plotted for a solution gas drive reservoir. An example of the curve can be seen on the following page. As can be seen from the last FORTRAN statement above, the gas-oil ratio was given a low limit of ten per cent less than the initial gas oil ratio.

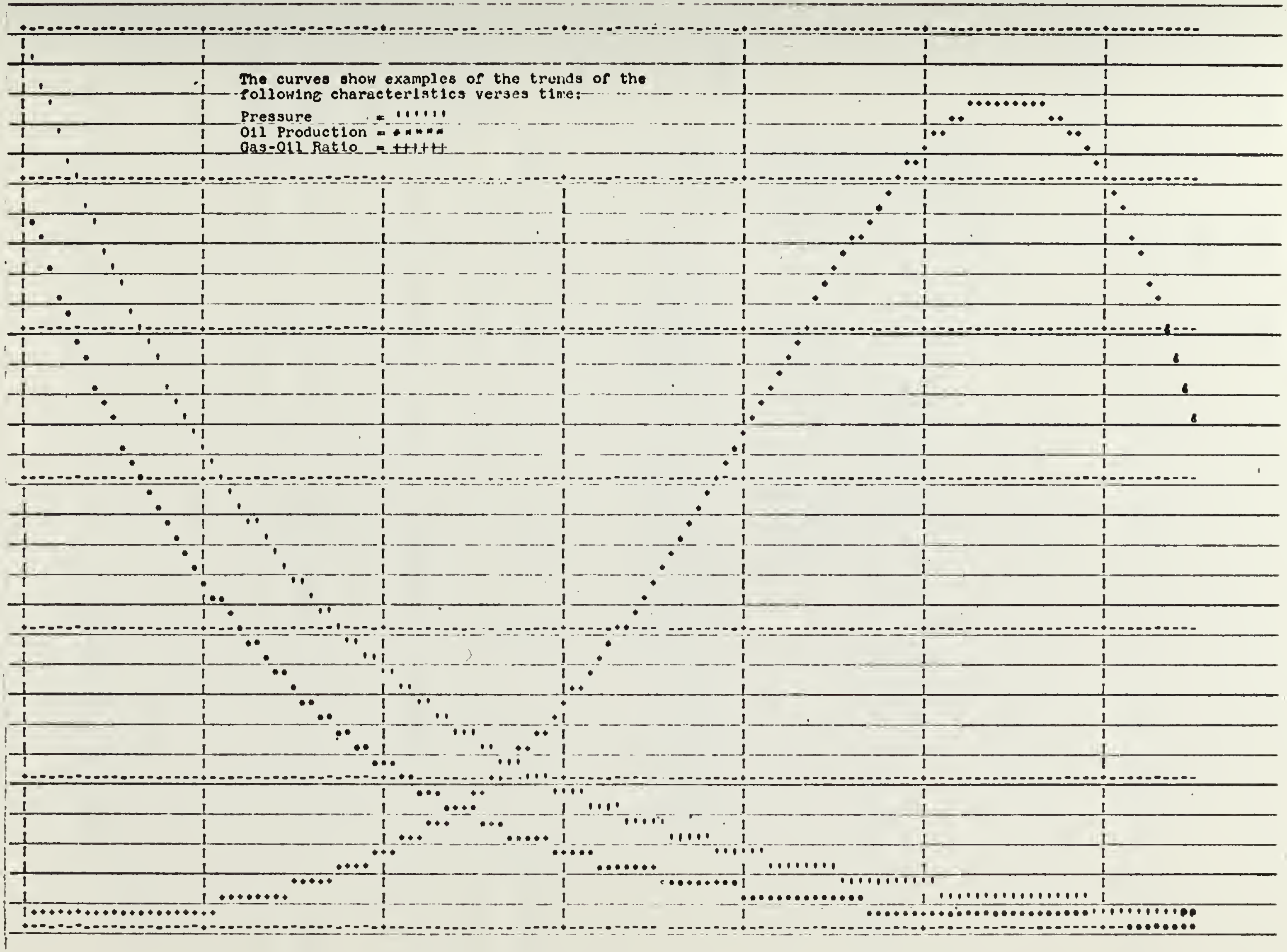
The next task undertaken is the selection of the wells from the well number array and the computation of the individual well's monthly production. Since OILFAC is computed in daily production, it must be multiplied by thirty to obtain the maximum monthly production rate.

---

```
      OILFAC = OILFAC * 30.
      DO 683 K = 1,1000
      IF (WELNUM(K,1).EQ.TEMP) GO TO 684
      GO TO 683
  684 PRDOIL = PRDOIL + OILFAC * WELNUM(K,2)
  683 CONTINUE
```

Where: PRDOIL = the monthly production of oil

---


The curves show examples of the trends of the following characteristics verses time:
Pressure = ''''''
Oil Production = ******
Gas-Oil Ratio = ++++++

When the program comes to a well number assigned to the lease in array WELNUM(K,1), it calculates the well production by multiplying the well factor times the maximum average monthly production. At the same time this result is added to the sum of the production from the other wells on the lease.

Next, the total monthly production is checked against the allowable production for the month.

---

```
X = NWELLS(II)
HOLD2 = PRDOIL
IF (PRDOIL .GT.X*OILALW) PRDOIL = X * OILALW
PRDGAS = PRDOIL * GOR * 0.001
IF (PRDGAS    .GT.X*GASLALW) PRDGAS = GASALW * X/(GOR * 0.001)
PRDGAS = PRDOIL * GOR * 0.001
OILPRD(II) = OILPRD(II) + PRDOIL
GASPRD(II) = GASPRD(I)  + PRDGAS
TIME(II) = TIME(II) + PRDOIL/HOLD2

Where: GASALW = the allowable gas production for the month
       OILALW = the allowable oil production for the month
       X      = the number of producing wells on the lease
       PRDGAS = the monthly production of gas
```

---

The program limits the production of oil to that of the monthly oil allowable. Next, the gas production is computed and if the gas production exceeds the monthly gas production allowable, the amount of oil produced is limited to the amount that will produce the gas allowable. The cumulative time of production for the lease is now incremented by the fraction determined by dividing the amount of oil actually produced by the amount of oil that could have been produced if not limited by the oil or gas allowable. The program now proceeds to the drilling routines, the next month's production, or to the lease accounting routine.

Conclusion

The methods and procedures used to simulate lease development and production have been greatly simplified. The results obtained, however, are in the realm of possibility. With further study and development, this part of the model could be greatly refined to better simulate real life conditions.

# CHAPTER IV

# LEASE AND COMPANY ACCOUNTING

## Lease Accounting

Federal taxation is a major consideration before transactions on property can be completed, for about half of the net operating income of a company is paid out as corporate taxes.[8] An important deduction that is taken before the calculation of Federal taxes that oil companies enjoy is the depletion allowance deduction. This allowance is granted as a return of investment in a piece of property theoretically at the same rate that the property depreciates in value as the oil is removed.

Section 614(a) of the Internal Revenue Code states: "For the purpose of computing depletion allowance in the case of mines, wells, and other mineral deposits, the term 'property' means each separate interest owned by the taxpayer in each mineral deposit in each separate tract or parcel of land." This is interpreted to mean that to be a unit of land for depletion computation purposes, the taxpayer must have the same interest in all parts of the unit, he must have acquired them at the same time, the unit must be a contiguous tract, and the unit must have been acquired from the same assignor.[9] For the purposes of this simulation, each lease will be considered as a single unit for the computation of depletion. It was necessary to perform the lease accounting before the company accounting because depletion must be calculated on a single unit basis.

<u>Gross Income Per Lease</u>

The first step in lease accounting is to compute the gross revenue produced from the operation of the lease.

---

```
        REVNUE(II) = OILPRD(II) * OPRICE + GASPRD * GPRICE

 Where: REVNUE(II) = the total income for the lease
        OILPRD(II) = the amount of oil produced on the lease for the
                     simulated time period in standard tank barrels
        GASPRD(II) = the amount of gas produced on the lease for the
                     simulated time period in thousands of standard
                     cubic feet
        OPRICE     = selling price of oil per barrel
        OPRICE     = selling price of gas per thousand cubic feet
```

---

The assumption is made in the simulation that all of the oil and gas that is produced on the lease is sold immediately. OPRICE, the selling price of oil, and GPRICE, the selling price of gas, are parameters that are set at the initial starting point by the model administrator. The simulation of market fluctuation of prices such as seasonal variences can be accomplished by the variation of oil and gas prices by the model administrator if desired.

The next phase is to compute the royalty payment and the gross income.

---

```
        ROYLTY(II) = ROYL * REVNUE(II)
        GROSS(II)  = REVNUE(II) - ROYLTY(II)

 Where: ROYLTY(II) = amount of royalties paid out of revenues
        ROYL       = rate of royalty payments
        GROSS      = the gross income for the lease
```

---

The amount of royalty paid to the lessor is computed by multiplying the royalty rate ROYL times the earned revenue REVNUE(II). The royalty

rate is normally set by the terms of the lease, but in the simulation the royalty rate ROYL is a parameter set by the model administrator usually at the initial starting point and it is not changed during the simulation.

The gross income of the lease, which is represented by the variable GROSS(II), is simply the total revenue minus the royalties paid.

## Equipment Renewal

There is a certain amount of tangible equipment on a producing oil lease, such as pumps, separators, pipes, tanks, etc., that is used to get the oil out of the reservoir and process it for shipment. This tangible equipment will wear out with age and must be serviced or replaced. In the model, the companies are allowed to renew tangible equipment on a maximum of eight leases per simulated time period.

---

```
      READ (5,11) (RENEW(I,J,1), J = 1,8)
      READ (5,11) (RENEW(I,J,2), J = 1,8)
      . . . . . . . . . . . . . . . . . . .
      DO 604 K = 1,8
      IF (RENEW(I,K,1).LE.0.01) GO TO 608
      N = RENEW(I,K,1)
      IF (N.EQ.LESSEE(I,J)) GO TO 605
  604 CONTINUE
```

Where: RENEW(I,K,1) = the array holding the numbers of the leases where the requested equipment renewal is to be made

RENEW(I,K,2) = the array holding the amount in dollars of the equipment to be renewed

N = a temporary variable used to change a floating point variable to a fixed point variable

---

To renew equipment on a lease, the student punches the lease numbers of the leases on which it is desired to renew equipment in the first equipment renewal card starting in the left most field. In the

corresponding field, on the second equipment renewal card, is punched the dollar amount value of the equipment desired to be renewed.

When the computer reaches the equipment renewal section on the model, it tests to see if the company, whose leases it is processing on a particular loop, desires to renew equipment on any of its leases. If the company does desire to renew equipment on a lease, the lease numbers of the requested equipment renewals are checked to determine if the lease being processed is one of them. If there is no equipment to be renewed on the lease being processed, the program by-passes the equipment renewal section. When there is equipment to be renewed, the program computes a factor to determine the effect of the renewal on the overall life of the equipment and the variable cost factor.

---

```
605 FACTOR = (EQCOST(II) - TANG(II))/RENEW(I,K,2)
    IF (FACTOR.LT.0.75) FACTOR = 0.75
    IF (FACTOR.GT.20.0) FACTOR = 20.0
```

```
Where: FACTOR     = a variable which is an indicator of the effect
                    of the amount of equipment renewal on the equipment
                    life
       EQCOST(II) = original equipment cost
```

---

The variable FACTOR is computed by dividing the equipment depreciation, which is equal to the original cost EQCOST(II) less the undepreciated value contained in the variable TANG(II), by the value invested in the renewed equipment. Limits were then set on FACTOR for the following two reasons. First, the FACTOR is limited to a lower limit of 0.75, because it was felt that if all of the equipment was completely replaced and also taking into account improvements on the equipment, the new equipment would probably not increase effectiveness much more than

twenty-five per cent over the original equipment when it was new. Second, the upper limit was established to prevent a very small renewal request from jamming the program. The number twenty was an arbitrary number.

---

```
TANG(II) = TANG(II) + RENEW(I,K,2)
IF (EQCOST(II).LT.TANG(II)) EQCOST(II) = TANG(II)
```

---

The first statement above adds the amount of renewal to the undepreciated amount of the equipment in order that a new depreciation schedule will be followed. Next, the original cost of the old equipment is compared with the new equipment cost. If the new equipment cost is higher, the original cost is set equal to the new amount.

When the equipment is completely renewed, the equipment variables in the program are returned to the state they were in when the equipment was new.

---

```
        VCFACT(II) = VCFACT(II) * FACTOR
        RQAGE(II)  = 0.0
        EQLIFE(II) = EQLIFE(II)/FACTOR

 Where: VCFACT(II) = the variable cost factor for determining the variable
                     production cost per barrel of oil
        EQLIFE(II) = the expected life of the equipment in months
        EQAGE(II)  = the age of the equipment in months
```

---

The variable VCFACT(II) is used to compute the variable production cost per barrel of oil. This cost factor is originally set in by the model administrator for what might be termed as standard original equipment. If improved equipment is installed, the basic cost factor is reduced by dividing it by the effect variable FACTOR. Next, the equipment

age for the lease, represented by the variable EQAGE(II), is set to zero for the equipment is supposedly returned to its original or better condition. Also, if better equipment is installed, the equipment life is usually longer than that of the original equipment. The new equipment life is extended by dividing the original equipment life, represented by EQLIFE(II), by FACTOR and the quotient is stored back in EQLIFE(II).

---

```
    IF (FACTOR.GT.1.0) GO TO 607
    . . . . . . . . . . . . . . . . . . . . .
607 EQLIFE(II) = EQLIFE(II) + EQAGE(II)/FACTOR
```

---

The amount of money invested in equipment renewal at times will be less than the amount of the original equipment depreciation. When this happens, the equipment life is increased by adding an amount equal to the equipment age or EQAGE(II) divided by FACTOR. As will be shown later, this will effectively reduce the variable production costs per barrel of oil.

Lease Operating Costs

Lease operating costs are defined for this work as the direct costs to operate the lease. The fixed cost portion is the cost of labor which includes both the hourly wage and fringe benefits. The variable cost portion concerns the costs occuring from the use of power for pumps and compressors, and equipment maintenance costs including both labor and parts.

---

```
608 TEMP = NWELLS * 10
    VAR  = VCFACT(II) * EXP(EQAGE(II)/EQLIFE(II))
    OPCOST(II) = XLNGTH * TEMP * (PAY(I) + EMPBEN(I)) + VAR * OILPRD(II)
```

Where: VAR = the variable cost to produce one barrel of oil
OPCOST(II) = the total operating cost for the lease for this simulated time period

---

Variable production costs are computed as an exponential function utilizing the ratio of the equipment age to equipment life (EQAGE(II)/EQLIFE(II)). As mentioned above, variable costs will decrease if equipment is partially renewed, for the life of the equipment is increased which in turn reduces the value of the exponent. When equipment is completely renewed or improved equipment is installed, EQAGE(II) is set to zero and the value of the function is one, therefore, variable production costs start back at the bottom of the curve and are equal to VCFACT(II). In the case of improved equipment being installed, EQLIFE(II) was increased which effectively will delay the buildup of variable costs resulting in a cost savings to the company.

Equipment Depreciation

Depreciation is defined as a reasonable allowance for the exhaustion, wear and tear, and normal obsolescence of property used in a trade or business.[10] This allowance is deductable from revenues before computing the Federal tax on income.

Depreciation can be calculated by one of three methods: the straight line method, the declining balance method, or the sum of the year-digits method.[11] Any one of the three methods may be chosen, but once a method is chosen, it cannot be changed, with one exception. The 1954 Tax Code allows property owners to change from the declining balance method to the straight line method as long as the new rate is less than or equal to the rate that would have resulted if the straight line method had originally been used.[12]

The model is programed in such a manner as to simulate the allowances of the Tax Code. Companies are allowed to either choose a depreciation method or elect to change a depreciation method on a maximum of eight leases per simulated time period.

---

```
      DO 610 K = 1,8
      IF (NELECT(I,K,1).EQ.II) GO TO 611
  610 CONTINUE
      GO TO 612
  611 IF (IELECT(II).EQ.0) IELECT(II) = NELECT(I,K,2)
      IF (IELECT(II).EQ.0) GO TO 616
      IF (NELECT(I,K,2).EQ.IELECT(II)) GO TO 612
      IF (NELECT(I,K,2).EQ.1.AND.IELECT(II).EQ.2) GO TO 620
      PENDEP(I,2) = PENDEP(I,2) + FINE
      PENDEP(I,1) = II
```

```
Where: NELECT(I,K,1) = the lease number of the lease for which a
                       depreciation method is to be chosen or changed
       NELECT(I,K,2) = the number of the method that is chosen or is
                       to be changed to
       IELECT(II)    = the array holding the elected method of deprecia-
                       tion for a lease
       PENDEP(I,1)   = the lease number of the lease for which an unlaw-
                       ful election of a depreciation method was made
       PENDEP(I,2)   = the array holding the total amount of fines awarded
                       for unlawful elections of depreciation methods
```

---

The program first checks to find out if the company has chosen, or has elected to change a depreciation method. A company may choose, or elect to change a depreciation method by punching the number of the lease, for which the desired choice or change is to be made, in the first field of the depreciation elect card. The method, chosen or elected to be changed, is punched into the corresponding field in the second depreciation elect card. If no lease numbers are detected, the program continues to the next section.

When a lease number is found, the depreciation method holding array IELECT(II) is tested to determine if the method entry is an

initial choice. If it is an initial choice, IELECT(II) will equal zero and the program will then set it equal to the method chosen. Should a company fail to punch a method in the second card and IELECT(II) equals zero, the model will allow no depreciation on the equipment on the affected lease for that simulated time period. The program next determines if an election to change depreciation methods is lawful. If it is not, the company is fined for attempting to make an unlawful change of depreciation methods and a notice is printed in the remarks section on the company's financial status sheet. The amount in the parameter FINE is the same amount used previously for penalties.

The holding array is now checked to find out what method of equipment depreciation is to be used.

---

```
612 IF (IELECT(II).EQ.0) GO TO 616
    IF (IELECT(II).EQ.1) GO TO 614
    IF (IELECT(II).EQ.2) GO TO 615
    IF (IELECT(II).GT.3) GO TO 609
```

---

Again if IELECT(II) equals zero which indicates now that an initial choice of depreciation method has not been made, no depreciation will be allowed for the lease equipment for that simulated time period. If IELECT(II) equals one or is greater than three, the straight line method will be used. If IELECT(II) equals two, the declining balance method will be used. If IELECT(II) equals three, the sum of the year-digits method will be used.

---

```
614 DEPREC(II) = TANG(II)/EQLIFE(II)
    IELECT(II) = DEPREC(II)
    GO TO 616
609 DEPREC(II) = IELECT(II)
```

Where: DEPREC(II) = the amount of depreciation to be taken for the lease for this period

---

When the straight line method of depreciation is initially chosen, the program computes the amount of depreciation per month that can be taken for the lease by dividing the depreciable value of the equipment by the expected life of the equipment (TANG(II)/EQLIFE(II)). The amount of depreciation is then stored in IELECT(II) in order that the same amount can be used until the equipment is completely depreciated in value. If equipment is renewed on the lease and the straight line method is being used for that lease, IELECT(II) is reset equal to one and the program recomputes a new rate of depreciation and stores it in IELECT(II).

For computation of depreciation by the declining balance method, the following formula was used:

BOOK VALUE AT THE END OF Uth YEAR = $P(1 - D)^U$ [13]

Where: P = the initial cost of the equipment
D = the constant depreciation rate
U = the last year depreciation was taken

---

```
   615 DRATE = 24./EQLIFE(II)
   . . . . . . . . . . . . . .
       TEMP  = MESES/12
       TEMP  = EQCOST(II) * (1.0 - DRATE)**TEMP
       GO TO 619
   . . . . . . . . . . . . . .
   619 DEPREC(II) = DRATE * TEMP * TIMFAC
```

Where: DRATE = the constant depreciation rate
TEMP = a temporary variable used as both the year for which book value is being computed and the book value computed
TIMFAC = the fraction of a year that the simulated period represents

---

The constant depreciation rate or DRATE is computed by dividing twenty-four by the equipment life (24./EQLIFE(II)) since the rate is

actually twice the fractional part of the cost per year that would be taken as depreciation using the straight line method. The number twenty-four was used because EQLIFE(II) is in months. A temporary variable TEMP is now used to store the number of the year that depreciation was last taken. This is computed by dividing the total amount of simulated time that is stored in MESES by twelve. Temp is again used to store the book value which is computed for the end of that year. Finally, the depreciation is calculated by multiplying the book value at the end of the previous year times the constant depreciation rate, times the fraction of the year being simulated for this period.

The sum of the year-digits method is actually calculated by months instead of years. The annual result will be the same although the monthly amount will vary a small amount.

---

```
      LIFE = EQLIFE(II)
      DO 640 K = 1,LIFE
      X = K
  640 TEMP = TEMP + X
      X = EQAGE(II) + 1.0
      IF (EQAGE(II).LE.0.01) X = 0.0
      DO 641 K = 1,LENGTH
      DEPREC(II) = DEPREC(II) + (EQLIFE(II) - X)/TEMP * EQCOST(II)
  641 X = X + 1.0
      GO TO 616
```

Where: LIFE = equipment life as a fixed point variable
TEMP = a temporary variable representing the sum of the months digits
LENGTH = length in months of the simulated period being run

---

The first four statements above compute the denominator of the digits fraction. This number will be the same for the life of the equipment unless the equipment is partially renewed, however, it is

recomputed each time to save computer storage space. The depreciation is determined by a summation of the depreciation calculated for each month for the number of months in the simulated period.

<u>Net Income Before Depletion</u>

Net income before depletion is calculated next in order to determine which type of depletion method will be used.

---

```
        TEMP = GROSS(II) - XLOSS(II) - DEPREC(II) - DRILCS(II) - OPCOST(II)

 Where: TEMP       = a temporary variable in which net income before
                     depletion is stored
        DRILCS(II) = drilling costs that are deductable as expense
        XLOSS(II)  = losses that are deductable
```

---

Net income before depletion is found by subtracting deductable expenses from gross income. The deductable expenses are deductable losses, depreciation, deductable portion of drilling costs, and lease operating costs.

<u>Depletion</u>

Depletion for intangible assets may be compared with depreciation for tangible assets. It is an allowance for the decrease in value of the lease as the oil and gas are removed.

Two methods of computing depletion are used. One is cost depletion and the other is percentage depletion.

---

```
        HOLD2 = INTANG(II) * OILPRD(II)/RESORS(II)
        RESORS(II) = RESORS(II) - OILPRD(II)
```

```
Where: HOLD2      = a temporary variable where the cost depletion
                    amount is stored
       RESORS(II) = the amount of recoverable oil that is estimated
                    to be in the reservoir for this lease
       INTANG(II) = the intangible assets assignable to the lease
```

---

Cost depletion is calculated by multiplying the uncapitalized intangible assets represented by INTANG(II) times the fraction produced by dividing the amount of oil produced or OILPRD(II) by the amount of recoverable oil in the reservoir. The intangible assets are then reduced by the calculated amount of depletion, and the recoverable oil in the reservoir is reduced by the amount of the oil produced.

---

```
      IF (TEMP.LE.HOLD2) GO TO 617
      . . . . . . . . . . . . . . .
  617 DEPLET(II) = HOLD2

Where: DEPLET(II) = the amount of depletion computed for the lease
                    for this time period
       TEMP       = the temporary variable representing net income
                    before depletion
       HOLD2      = the temporary variable representing the cost
                    depletion amount calculated for the period
```

---

The first statement tests to determine if the amount of cost depletion calculated is greater than the net income before depletion. If the cost depletion is greater, the cost depletion amount is the amount of depletion to be used for the lease for this period, and percentage depletion is not calculated. This normally occurs during the early stages of lease development when drilling costs are high and production is low.

When the cost depletion amount is less than the net income before depletion, percentage depletion is then computed.

---

```
PERDPL = 0.275 * GROSS(II)
IF (PERDPL.GT.(0.5 * TEMP)) PERDPL = 0.5 * TEMP
IF (PERDPL.GT.HOLD2) DEPLET(II) = PERDPL
```

Where: PERDPL = the amount of percentage depletion calculated

---

Percentage depletion is defined as twenty-seven and one half per cent of the gross income, but it is limited to fifty per cent of the net income before depletion. The percentage depletion amount is calculated in the first statement above and compared to the limitation of fifty per cent of net before depletion in the second statement. It is then checked to see if cost or percentage depletion is greater. The larger value of the two will be the amount of depletion used.

<u>Net Income Before Taxes</u>

Net income before taxes is computed to provide a gage to determine how well the lease is doing toward contributing to the income of the company.

---

```
623 BTXNET(II) = TEMP - DEPLET(II)
```

Where: BTXNET(II) = the net income before taxes

---

The net income before taxes amount is computed by subtracting the calculated depletion allowance from the net income before depletion.

## Company Accounting

The purpose of the accounting for the company transactions is to reflect the financial position of the companies at the end of each

simulated time period. This position can be utilized by analysis to base future financial and engineering decisions upon. It can also be used by the model administrator to grade the progress of the companies. The accounting procedure might be thought of as simply keeping score for the companies and the Financial Status Sheet reflects the final score at the end of the period.

It is common in real life for companies to keep two sets of accounting books: one set for tax purposes and one set to "present a sound picture of the economics surrounding a venture."[14] This model effectively uses only one set of simulated books that attempts to perform the functions of the two.

At the initial starting point of the simulation, all companies start at the same financial position. Each company will have an equal amount of current and fixed assets distributed in the same manner.

To start the accounting process for a simulated time period, the companies' present financial status according to the balance sheet is read into the computor.

---

```
        DO 110 I = 1,NPLAY
        READ (5,11) CASH(I),ASSETS(I),ACCREC(I),ACCPAY(I),INVEST(I),
        STLOAN(I),BONDS(I),MQUCTE(I)
        . . . . . . . .
    110 CONTINUE

 Where: CASH(I)   = the cash on hand
        ASSETS(I) = the total assets of the company
        ACCREC(I) = the accounts receivable
        ACCPAY(I) = the accounts payable
        INVEST(I) = the outside investments of the company
        STLOAN(I) = the amount of short term loans outstanding
        BONDS(I)  = the amount of bonds outstanding
        MQUOTE(I) = the present market quote
```

---

At the initial starting point of the simulation, the values read in are punched in the cards of the starting data deck. An administrator may easily change these values if he so desires. The market quote, indicated above, will equal the book value at the start of the simulation.

## The Acquisition of Capital

The acquisition of capital by a company is very important to its financial stability. The right amount of capital must be on hand at all times to take advantage of opportunities within the scope of the company's operations as the opportunities present themself. On the other hand, idle cpaital is costly and should not be accumulated without a need for it.

The program provides three methods to acquire capital: by obtaining a short term loan, by selling bonds which is considered a long term loan, and by selling stock. The first method to be discussed is a request for a short term loan.

---

```
        IF (REQLNS(I).LT.0.1) GO TO 127
        CRATIO = (CASH(I) + ACCREC(I))/(ACCPAY(I) + STLOAN(I))
        IF (CRATIO.LE.2.0) REQLNS(I) = 0.0
        IF (CRATIO.LE.2.0) GO TO 129
        TEMP = (CASH(I) + ACCREC(I) - 2.0 * ACCPAY(I))/2.0 - STLOAN(I)
        IF (REQLNS(I).LE.TEMP) GO TO 129
        REQLNS(I) = TEMP

 Where: REQLNS(I) = the amount a company is requesting for a short term
                    loan
        CRATIO    = the ratio of current assets to current liabilities
        TEMP      = the maximum amount that can be borrowed as a short
                    term loan to make the current ratio equal to two
```

---

The first statement above tests to see if the company has requested a short term loan, and if it has not the program bypasses this routine. If it has, the current ratio is next computed for the company.

The current ratio, sometimes referred to as the "bankers' ratio" is frequently used to measure a company's ability to pay its bills by money lending organizations.[15] A common ratio used is a ratio of 2-to-1, however, some authors question the validity of using the current ratio as a measure of the financial strength of a company.[16] This 2-to-1 ratio is used as a standard in the model to limit the amount a company may borrow by using the short term loan. If the company's current ratio is less than or equal to the standard, company will not get the loan, and the request will be ignored. If the current ratio is greater than the standard, the program computes the amount that will make the ratio equal to the standard. It then compares this amount with the amount of the loan requested. When the amount requested is less than the amount that will make the ratio equal to the standard, the total amount requested will be loaned to the company. When the amount requested will make the current ratio less than the standard, the amount loaned is limited to the amount that will make the current ratio equal to the standard.

Companies may pay off short term loans by requesting a minus loan.

---

```
127 IF (REQLNS(I).LT.(-0.1)) GO TO 128
    GO TO 129
128 STLOAN(I) = STLOAN(I) + REQLNS(I)
    CASH(I)   = CASH(I)   + REQLNS(I)
```

---

Companies have the option of paying off short term loans at their discretion. In the last two statements above, since in both cases the loan request, REQLNS(I), will be negative, adding the value of the request to cash and short term loans will reduce their values by the amount of the request.

The next method of capital acquisition is by borrowing of a long term loan which is the selling of bonds in the model.

---

```
      IF (REQBND(I).LT.0.1) GO TO 706
      TEMP = PAYCAP(I) + RTEARN(I)
      IF (BONDS(I).GE.TEMP) REQBND(I) = 0.0
      IF (BONDS(I).LT.TEMP) TEMP = TEMP - BONDS(I)
      IF (TEMP.GE.REQBND(I)) GO TO 706
      REQBND(I) = TEMP

Where: REQBND(I) = the amount of the bonds requested to be sold
       BONDS(I)  = the amount of the bonds the company has outstanding
       TEMP      = a temporary holding variable
```

---

The debt/equity ratio is the ratio of the long-term debt to the total of the long-term debt plus the ownership investments, the ownership investments being the paid in capital plus the retained earnings.[17] A debt/equity ratio of fifty percent is used to limit the companies from borrowing. The debt/equity will be fifty per cent when the amount of bonds is equal to the sum of the paid in capital plus the retained earnings. When a company has bonds outstanding equal to the sum of the paid in capital plus the retained earnings, they will not be allowed to sell more bonds. When they request to sell bonds, and the debt/equity ratio is less than fifty per cent, the companies may sell bonds until the ratio becomes fifty per cent.

The last method of obtaining capital for investment is to sell shares of company stock.

---

```
  709 BISTOK = SOLDST(I) * MQUOT(I)
      PAYCAP(I) = PAYCAP(I) + BISTOK
      CASH(I) = CASH(I) + BISTOK
      SHARES(I) = SHARES(I) + SOLDST(I)
```

```
Where: SOLDST(I) = the number of shares of stock to be bought or sold
       BISTOK    = a temporary variable holding the value of the stock
                   either bought or sold
       SHARES(I) = the shares of stock outstanding
```

---

The companies may sell stock at any time in any amounts by merely requesting the number of shares to be sold that they desire. The selling price will be the new market quote at the end of the simulated period which will not be known to the companies. The cash and the number of shares outstanding will be adjusted accordingly. This routine may also be used by companies who wish to invest in their own stock by buying it at the going market rate. This can be accomplished by requesting a number of minus shares to be sold.

Adjusting Payables and Receivables

The paying of outstanding bills thereby reducing accounts payable, and the collecting of outstanding receipts thereby reducing accounts receivable is executed in the early part of the program.

---

```
   129 TEMP = XLNGTH/TERMSR
       IF (TEMP.GT.1.0) TEMP = 1.0
       CASH(I) = CASH(I) + ACCREC(I) * TEMP
       ACCREC(I) = ACCREC(I) * (1.0 - TEMP)
       TEMP = XLNGTH/TERMSP
       IF (TEMP.GT.1.0) TEMP = 1.0
       CASH(I) = CASH(I) - ACCPAY(I) * TEMP
       ACCPAY(I) = ACCPAY(I) * (1.0 - TEMP)

Where: TERMSR = the term in months in which the total amount of
                accounts receivable will be collected
       TERMSP = the term in months in which the total amount of
                accounts payable will be paid
       TEMP   = a temporary holding variable
```

---

The two variables indicated above as TERMSR and TERMSR are parameters set by the model administrator at the beginning of the simulation. They determine the amount of time it takes to collect all of the receivables of a company, and the amount of time it takes to pay all of the payables of a company. The value of these variables must be read into the computor in months. A fraction is computed by dividing the length of the simulated time period in months by the value of either TERMSR or TERMSP, whichever is being calculated. This fraction is limited to one in order to prevent more receivables from being collected than are outstanding, or more payables being paid than are due. It can easily be seen that if XLNGTH equals either TERMSR or TERMSP, the total amount outstanding will be either collected or paid, whichever is appropriate.

## Lease Transactions

Transactions involved in the purchase, sale, reversion, and abandonment of leases are carried out as they occur. The first transaction to be discussed is the sale of leases by the model administrator.

---

```
213 CASH(I) = CASH(I) - HOLD2 * CASHFT
    ACCPAY(I) = ACCPAY(I) + HOLD2 * (1. - CASHFT)
    . . . . . . . .
221 IF (NWELLS(II).NE.0.AND.NDEAL.EQ.0) EQCOST(II) = HOLD2 * EQCSFT
    IF (NDEAL.EQ.0).TANG(II) = EQCOST(II)
    NPDATE(II) = MESES + 1
    INTANG(II) = HOLD2 - TANG(II)

 Where: CASHFT = the per cent of the payment that must be in cash
        EQCSFT = the per cent of the purchase price that is estimated to
                 be the cost portion related to the tangible equipment
        HOLD2  = a temporary variable representing the purchase price
                 of the lease
```

---

First, the cash portion of the payment for the lease purchased is paid, which reduces the total cash of the company. The remaining portion of the payment is added to the accounts payable account of the company. Next, if the lease being purchased is a partially or fully developed lease, the program uses the parameter, EQCSFT, to determine how much of the purchase price is the cost of the tangible equipment on the lease. The purchase date of the lease is then recorded in the array, NPDATE(II), and the remaining part of the purchase price is considered as an intangible asset and stored in the array, INTANG(II).

When the sale of a lease occurs between two companies, the transaction for the purchasing company is the same as if the lease had been bought from the administrator. The transaction for the selling company is handled in the following manner.

---

```
220 HOLD1 = TANG(II) + INTANG(II)
    IF (HOLD2.GT.HOLD1.AND.MESES=NPDATE(II).GT.6) GAINLT(NDEAL) =
   1 GAINLT(NDEAL) + HOLD2 - HOLD1
    IF (HOLD2.LT.HOLD1.AND.MESES-NPDATE(II).GT.6) XLOSLT(NDEAL) =
   1 XLOSLT(NDEAL) + HOLD1 - HOLD2
    IF (MESES - NPDATE(II).LE.6.AND.HOLD1.GT.HOLD2)
   1 OTHLOS(NDEAL) = OTHLOS(NDEAL) - HOLD2 + HOLD1
    IF (MESES - NPDATE(II).LE.6.AND.HOLD1.LT.HOLD2)
   1 OTHINC(NDEAL) = OTHINC(NDEAL) + HOLD2 - HOLD1
    CASH(NDEAL) = CASH(NDEAL) + HOLD2 * CASHFT
    ACCREC(NDEAL) = ACCREC(NDEAL) + HOLD2 (1. - CSAHFT)
```

Where: GAINLT(NDEAL) = the gain realized by the selling company on a lease held over six months
XLOSLT(NDEAL) = the loss realized by the selling company on a lease held over six months
OTHLOS(NDEAL) = the array holding the selling company's ordinary business losses
OTHINC(NDEAL) = the array holding the selling company's income that is from other sources than normal operations
HOLD1 = the total amount of undepleted and undepreciated assets of the selling company in the lease sold
HOLD2 = the selling price of the lease
NDEAL = the variable that represents the selling company

---

When one company sells a lease to another company, the selling company ordinarily realizes either a capital gain or loss. This gain or loss may be put into one of two classes, either it is a long term capital gain or loss or it is a regular business income or loss from a source other than normal operations. The classification into which a gain or loss falls is determined by the length of time a company has owned the asset. If the lease has been owned for more than six months, the gain or loss is considered long term. If the company has owned the lease for six months or less, the gain or loss is considered as a regular business income or loss.[18]

The first and second Fortran statements above check to determine if there is a gain or loss and if the gain or loss can be classified as long term. The next two statements check to determine if there is a gain or loss and if it can be classified as regular income or loss. Only one of the four statements will be true for each transaction, and that statement will calculate the gain or loss and store it in the proper array.

After all of the transactions for the simulated time period have been completed, the net long term gain, if any, is computed.

---

```
IF (GAINLT(I).GT.XLOSLT(I)) GAINLT(I) = GAINLT(I) - XLOSLT(I)
IF (GAINLT(I).LE.XLOSLT(I)) GAINLT(I) = 0.0
```

---

The net long term gain is then held for tax purposes and will be explained later in the section of this chapter on taxation. All long term capital losses that cannot be matched against long term capital gains are considered ordinary losses and are matched against regular income. This

procedure of matching long term losses against regular income is contrary to the tax laws presently in force, however, it was executed in this manner because it was simplier to program and no carry back or carry over is involved.[19] Also, the model takes no action under Section 1245 and Section 1250 of the tax law which concerns the recapture of depreciation as ordinary income when a long term gain is realized.[20]

The transactions involved in lease reversions concern the accounting for the intangible assets invested in the lease to be reverted.

---

```
      IF (MESES-NPDATE(II).LE.6) OTHLOW(I) = OTHLOS(I) + INTANG(II)
      IF (MESES-NPDATE(II).GT.6) XLOSLT(I) = XLOSLT(I) + INTANG(II)
```

---

When leases are reverted, the only capitalized asset invested in the lease is normally the bonus paid for the lease which is considered as an intangible asset. The two Fortran statements above determine if the loss is a long term or an ordinary loss and stores the amount in the proper array.

The same method is used for the transactions involving lease abandonment, however, there may be some tangible assets that must be included and also the costs of abandoning the lease must be accounted for.

---

```
  254 WELLS = NWELLS(II)
      ABDCOS(I) = ABDCOS(I) + WELLS * ABDNFT
      IF (MESES-NPDATE(II).LE.6) OTHLOS(I) = OTHLOS(I) + INTANG(II)
     1 + TANG(II)
      IF (MESES-NPDATE(II).GT.6) XLOSLT(I) = XLOSLT(I) + INTANG(II)
       + TANG(II)
```

Where: ABDCOS(I) = the total abandonment costs of a company for the simulated time period

ABDNFT = the cost per well of abandoning the lease

WELLS = the number of wells on the lease being abandoned

---

The cost of abandoning the lease is considered a direct operating expense. It is computed by multiplying the number of wells on the lease being abandoned by the abandonment cost factor, ABDNFT. This abandonment cost factor is a parameter set by the administrator and is used to simulate the cost per well of filling in the wells, clearing the lease of tanks and piping, repairing the surface of the lease, and all other costs associated with lease abandonment.

<u>Lease Development Costs</u>

The first cost to be discussed under lease development is the cost of drilling a dry hole.

---

```
        EANDD(I) = EANDD(I) + DRYHCS

 Where: EANDD(I) = the array holding the deductible costs of exploration
                   and development of the companies
        DRYHCS   = the cost of drilling a dry hole
```

---

When a dry hole is drilled, the cost of drilling the dry hole is written off as an expense. The cost per well is represented by the parameter, DRYHCS, which is an estimated cost of drilling a dry hold to some average depth.

When a discovery or development well is drilled, the cost of drilling must be broken into two segments: the intangible drilling costs that are immediately expensed and the tangible drilling costs that are stored in the array TANG(II) and must be depreciated.

---

```
        DRILCS(II) = DRILCS(II) + DRINTG
        CASH(I) = CASH(I) - CASHFT * DRTANG
        ACCPAY(I) = ACCPAY(I) + (1.0 - CASHFT) * DRTANG
```

```
      TANG(II) = TANG(II) + DRTANG
      EQCOST(II) = EQCOST(II) + DRTANG

Where: DRILCS(II) = the total amount of drilling costs the company may
                    expense for the lease during a simulated time period
       DRINTG     = the intangible portion of the costs of drilling a
                    well
       DRTANG     = the tangible portion of the costs of drilling a well
```

---

The intangible costs of drilling a well include all costs of clearing the land, making roads, completing the well, buying and installing temporary equipment necessary for the drilling operation, and installing tangible equipment in the well.[21] Tangible costs of drilling a well include the costs of the equipment in the well such as the cemented casing even though it is not recoverable, and the costs of all equipment on the lease such as pipelines, tanks, separators, etc., that is necessary for the production of oil and gas from the well.[22] The tangible drilling costs must also be added to the value of the equipment cost already on the lease in order that the proper depreciation rate will be calculated.

As part of lease development, well treating costs are handled in a similar manner. If the fracturing or the acid treating of a well is not successful, the costs are expensed.

---

```
  687 EANDD(I) = EANDD(I) + FRCCOS
      . . . . . . . . .
  688 EANDD(I) = EANDD(I) + ACDCOS

Where: FRCCOS = the average cost of fracturing a well
       ACDCOS = the average cost of acid treating a well
```

---

The costs of a successful well fracture, of a successful acid treatment, of the installation of pumps, and of the installation of a secondary recovery system are all accounted for by the same method.

---

```
676 X = NWELLS(II)
    Z = X * FRCCOS
    . . . . . . . .
    Z = X * ACDCOS
    . . . . . . . .
    Z = X * PMPCOS
    . . . . . . . .
    Z = X * SECCOS
    . . . . . . . .
631 EANDD(I) = EANDD(I) + Z * 0.4
    Y = Z * 0.6
    TANG(II) = TANG(II) + Y
    CASH(I) = CASH(I) - Y * CASHFT
    ACCPAY(I) = ACCPAY(I) + (1. - CASHFT) * Y
    EQCOST(II) = EQCOST(II) + Y
```

Where: PMPCOS = the total cost of installing a pump on one well
SECCOS = the total cost of installing a secondary system on one well
Y = the tangible portion of the cost
Z = the total of fracturing, acid treating, installing pumps, or installing a secondary recovery system on a lease

---

It should be clear that part of the costs of the installation of pumps and a secondary system such as the cost of the necessary equipment, should be capitalized as tangible costs, and that the rest of the costs such as the labor to install the equipment, should be expensed as intangible costs. It is not so clear how the costs of a successful fracture or acid treatment should be handled. It was felt that since the well was of more value after the treatment, part of the costs of the treatment should be capitalized. The remaining costs should be expensed such as the costs of temporary equipment necessary to do the job. An arbitrary fraction of six-tenths was selected to represent that portion of the costs that are tangible costs. This portion of the costs must also be added to the cost of the lease equipment in order that the proper depreciation rate may be computed.

Equipment Renewal Costs

The costs of renewing equipment on a lease are considered entirely as tangible costs.

---

```
TANG(II) = TANG(II) + RENEW(I,K,2)
CASH(I) = CASH(I) - RENEW(I,K,2) * CASHFT
ACCPAY(I) = ACCPAY(I) + RENEW(I,K,2) * (1. - CASHFT)
```

Where: RENEW(I,K,2) = the amount paid for the renewal of equipment on the lease

---

Any amount of capital spent on the renewal of lease equipment will be capitalized as a tangible asset as indicated by the first Fortran statement above. The company's cash and accounts payable are adjusted accordingly.

Depreciation and Depletion Accounting

The calculation of depreciation and depletion was discussed in the previous section of this chapter on lease accounting. The tangible assets of the lease are reduced by the amount of the depreciation, and the intangible assets of the lease are reduced by the amount of the depletion.

---

```
TANG(II) = TANG(II) - DEPREC(II)
. . . . . . . . .
INTANG(II) = INTANG(II) - DEPLET(II)
```

---

The Financial Status Sheet

As previously mentioned, the Financial Status Sheet is actually a scoreboard that displays each company's financial status. It also

shows some of the aspects of the industry in which the company is competing. The Financial Status Sheet is divided into four parts: the income statement, the balance sheet, the decisions and environment, and the remarks section.

The income statement is the first section of the Financial Status sheet to be discussed. The purpose of the income statement is to show the flow of the company's funds during the simulated time period. The result of the income statement shows the net profit and the change in the stockholder's equity for each simulated period.

The first item on the income statement is the revenue for the sale of oil and natural gas.

---

```
   621 TOTREV = TOTREV + REVNUE(II)

 Where: TOTREV = the total amount of revenue realized from the sale
                 of oil and natural gas by a company
```

---

The total revenue from the sale of oil and natural gas realized by a company is computed by adding the revenue from all of its producing leases.

The next item to be discussed are the operating expenses.

---

```
   657 DELAYR = DELAYR + ACRES/12
       . . . . . . . . .
       TOTRYL = TOTRYL + ROYLTY(II)
       TOTOPC = TOTOPC + OPCOST(II)
       TOTDPR = TOTDPR + DEPREC(II)
       TOTDPL = TOTDPL + DEPLET(II)

 Where: DELAYR = the total amount of delay rentals paid by a company
        TOTRYL = the total amount of royalties paid by a company
        TOTOPC = the total operating cost of a company
        TOTDPR = the total depreciation deduction allowed a company
        TOTDPL = the total depletion deduction allowed a company
```

---

The total amount for each expense is found by summing the expenses of all the leases that a company owns. The abandonment costs are not shown at this time because the method used was given previously in the section on abandonment costs. Drilling costs are not shown also, for it was demonstrated previously in the discussion of lease development costs.

Net operating income is now computed by summing up all of the operating expenses and subtracting that amount from the total revenue.

---

```
        TOTOPE = TOTRYL + DELAYR + DRILL + TOTOPC + TOTDPR + TOTDPL
       1 + ABDCOS(I)
        OPNET = TOTREV - TOTOPE

 Where: TOTOPE = the total operating expenses for the company
        DRILL  = the total amount of the intangible drilling costs for
                 the company
        OPNET  = the net operating income of a company
```

---

A company may have other income than the revenue from the sale of gas and oil. This income may be either capital gains or dividends received from its investments.

---

```
    706 DIVREC = DVRATE * INVEST(I) * TIMFAC
        . . . . . . . . .
        CPGAIN = GAINLT(I) + OTHINC(I)

 Where: INVEST(I) = the amount a company has invested in outside investments
        DVRATE    = the amount of the dividend rate per year
        DIVREC    = the amount of dividends received for the simulated
                    time period
        CPGAIN    = the total amount of capital gains of a company
```

---

The dividends received by a company are the return from its investments in other companies outside the industry. This dividend is

computed by multiplying the annual dividend rate, DVRATE, times the amount of the investment of the company times the fraction of a year that the simulated time period represents. The dividend rate is a parameter set by the model administrator at the beginning of the simulation.

Capital gains are the sum of the long term capital gains and the regular income realized on the sale of a capital asset.

The next item on the income statement to be discussed is termed as other expenses. Other expenses may be defined as those company expenses that are not directly related to the operation of a lease.

---

```
       INTPAY = (STLOAN(I) * STRATE + BONDS(I) * BDRATE) * TIMFAC
       . . . . . . . . .
       CPLOSS = XLOSLT(I) * OTHLOS(I)

Where: INTPAY = the total interest on the debts of the company
       STRATE = the short term loan interest rate
       BNRATE = the bond interest rate
       CPLOSS = the total capital losses for the company
```

---

Interest paid is the interest on all outstanding loans and bonds, and is computed by multiplying the appropriate rate, STRATE for short term and BDRATE for bonds, times the amount of each that is outstanding.

Capital losses are similar to capital gains in that they are the sum of the long term capital losses plus the regular losses realized on the sale of a capital asset.

Administrative expenses were computed as a percent of the total assets.

---

```
       ADMIN = ASSETS(I) * .02
       IF (ORCARY(I).LE.0.0) GO TO 707
       X = ADMIN * ORCARY(I)/ORBASE * 0.1
```

```
        IF (X.GT.ADMIN*0.5) X = ADMIN * 0.5
        ADMIN = ADMIN -X
        . . . . . . . .
        ORCARY(I) = ORCARY(I) + OPRES(I)
Where:  ASSETS(I) = the total assets of a company at the beginning of
                    the simulated period
        ORCARY(I) = the total amount a company has invested in operations
                    research
        OPRES(I)  = the amount of funds invested in operations research
                    for this simulated period
        ORBASE    = a parameter used as a base for investment in
                    operations research
```

---

Administrative expenses were computed as described in the following discussion, for it was felt that these expenses would probably be more of a function of total assets then of any other one item. As the model is constructed, administrative expenses may be decreased by investing in operations research. The total amount of funds invested in operations research is compared with the parameter ORBASE which is set by the model administrator at the beginning of the simulation and should not be divulged to the companies during the simulation. Investments by a company in operations research will not effect administrative expenses for the simulated period in which the investment was made, but the investment will affect the following period.

The exploration and development expenses are expenses connected with the exploration and development of the leases and are generally those expenses that are connected with leases which are not capitalized.

The total of these expenses is found by simple addition.

---

```
        OTHEXP = INTPAY + ADMIN + EANDD(I) + OPRES(I) + CPLOSS
        HOLD1  = 0.85 * DIVREC
        PRETAX = OPNET + TOTING - OTHEXP - GAINLT(I)
```

```
Where: OTHEXP = the total amount of a company's other expenses
       HOLD1  = the total amount of tax deductable dividends
       PRETAX = the amount of taxible income
```

---

Before federal and state taxes can be computed, the net taxable income must be determined. The net long term gain has already been calculated. The amount of deductable dividends is computed by multiplying the total amount of dividends received by eighty-five per cent. This is in keeping with the tax laws that state, in effect, that corporations may deduct eighty-five per cent of dividends received from other taxable domestic corporations.[23] The net taxable income is calculated by adding the net operating income to the total other income and then subtracting the total other expenses, the deductible dividends, and the net long term gain.

The model assesses the companies two classes of taxes: (1) federal income tax, and (2) state severance tax. The federal income tax is broken into two parts which are the normal federal corporation tax on income, and the tax on long term gains.

---

```
       TOTGRO = TOTGRO + GROSS(II)
       . . . . . . . . .
       STATAX = STAXR * TOTGRO
       FEDTAX = FTAXR * (PRETAX - STATAX)
       IF (PRETAX-STATAX.LT 0.0) FEDTAX 0.0
       . . . . . . . . .
       TAXLTG = .25 * GAINLT(I)

Where: GROSS(II) = the gross income of a lease
       TOTGRO    = the total gross income of all producing leases of
                   a company
       STAXR     = the state severance tax rate
       STATAX    = the amount of state tax paid by a company
```

FTAXR = the federal income tax rate
FEDTAX = the amount of federal income tax paid by a company
TAXLTG = the federal tax on long term capital gains

---

The gross incomes, which are the gross revenues minus the royalties paid, of all leases owned by a company are added together to produce the total gross income from the production of oil and gas which is stored in the variable, TOTGRO. The total state severance tax paid by a company is computed by multiplying the total gross income times a state tax rate, STRATE, that is a parameter set by the model administrator. The state tax is deducted from the net taxable income before the normal federal income tax is computed. If the net taxable income is less than the state tax, the federal tax will be equal to zero. The federal tax is calculated by multiplying the federal tax rate, FTAXR, times the result of the net taxable income minus the state severance tax.

The last tax that is charged is the tax on the long term gains. Corporations may not take a deduction of part of their long term capital gain as individuals do, however, they may allow themselves to be taxed at the rate of twenty-five per cent times their net long term capital gains.[24] The net long term capital gain in this case is the long term capital gains less the long term capital losses and less the short term capital losses.

The companies pay all taxes, as they occur, from cash.

---

```
CASH(I) = CASH(I) - STATAX - FEDTAX - TAXLTG
```

---

After the taxes are settled, the net income for the period and the change in stockholder's equity is computed.

---

```
      NETINC(I) = PRETAX - STATAX - FEDTAX - TAXLTG + GAINLT(I) + HOLD1
      . . . . . . . .
  731 EQUITY = NETINC(I) - PENLTY - DIVPAY + SELL - BISTOK

Where: NETINC(I) = the net income of a company
       EQUITY    = the change in the stockholder's equity for the period
       SELL      = the amount of money realized from selling stock
       BISTOK    = the cost of buying stock
       PENTLY    = the penalty paid for attempting to beat the model
```

---

Net income for a company is determined by subtracting the taxes paid from the net income before taxes. The change in stockholder's equity is calculated by subtracting the penalties paid, the dividends paid, and the stock purchased from the sum of the net income and the stock sold.

The balance sheet mainly reflects the distribution of the assets and liabilities of a company. Most of the calculations have already been given, such as many of those for cash and accounts receivable. The capitalized tangible and intangible assets are added for all of the leases of a company.

---

```
      TOTTAN = TOTTAN + TANG(II)
      TOTINT = TOTINT + INTANG(II)

Where: TOTTAN = the total tangible assets of a company
       TOTINT = the total intangible assets of a company
```

---

After all transactions have been completed for the period, the total assets are computed by summing all of the individual asset accounts of a company.

---

```
        ASSETS(I) = CASH(I) + ACCREC(I) + TOTTAN + TOTINT + INVEST(I)

 Where: ASSETS(I) = the total assets of a company
```

---

Most of the liabilities have been explained in the previous discussion of this section. Retained earnings and the total liabilities are calculated in the following manner.

---

```
        HOLD2 = RTEARN(I)
        RTEARN(I) = RTEARN(I) + NETINC(I) - PENLTY - DIVPAY + ADD
    740 TOTLIB = ACCPAY(I) + STLOAN(I) + BONDS(I) + PAYCAP(I) + RTEARN(I)

 Where: RTEARN(I) = the retained earnings of a company
        TOTLIB    = the total liabilities of a company
        HOLD2     = a temporary variable representing the retained
                    earnings of a company from the previous period
        ADD       = the depletion taken on a lease that cannot be matched
                    to a capitalized intangible asset of the lease
```

---

The retained earnings amount is found by adding the previous retained earnings, the net income for the period, and the depletion that cannot be matched against the capitalized intangible assets of a lease, and subtracting from this sum the penalties and dividends paid during the simulated time period. The total liabilities is the sum of all the liability accounts of a company.

The market quote and the book value of the stockholder's equity are computed by the following method.

---

```
        MQUOTE(I) = MQUOTE(I) + (RTEARN(I) - HOLD2/RTEARN(I) * MQUOTE(I)
        IF (MQUOTE(I).LT.1.0) MQUOTE(I).LT.1.0) MQUOTE(I) = 1.0
        MQUOTE(I) = MQUOTE(I) - MQUOTE(I) * (DIVBAS - DIVDND(I))/DIVBAS
       1 * QUOTFT
        IF (MQUOTE(I).LT.1.0) MQUOTE(I) = 1.0
        . . . . . . . . .
    742 BOOK = (PAYCAP(I) + RTEARN(I))/SHARES(I)
```

```
Where: MQUOTE(I) = the price a company's share of stock will sell
                   for on the open market
       DIVDND(I) = the dividend per share that is paid by a company

       DIVBAS    = a base dividend that should be paid by a company
       BOOK      = the book value of the stockholder's equity
```

---

The selling price of a company's stock on the open market or the market quote is thought to be the attractiveness of the company as an investment. People will normally like investments that give them a return on their money plus some growth indication in the company. The attempt to simulate these two factors has been made in computing the market quote. The first new market quote is determined by the per cent change in the book value of the stockholder's equity that is the result of company operations. The final market quote is computed by comparing the dividend being paid by the company to an average base dividend that would be paid by a normal operating company. This base dividend is a parameter set by the model administrator at the beginning of the simulation.

The book value of the stockholder's equity is calculated by dividing the sum of the paid in capital and the retained earnings by the number of the shares of the company's stock that are outstanding.

One of the final calculations to be made by the model is to determine if a company may need an emergency loan.

---

```
      IF (CASH(I).LE.0.0.) GO TO 703
      EMERG = ABS(CASH(I)) * 1.1
      CASH(I) = 0.0
  703 STLOAN(I) = STLOAN(I) + EMERG

Where: EMERG = the amount of the emergency loan that a company is forced
               to take
```

---

The emergency loan procedure is set up to keep a company's cash account from having a negative balance. If it does go negative during the company's transactions and remains negative after all transactions are completed, the company is forced to take an emergency loan to make the balance of the account equal to zero. When the emergency loan is taken, it is automatically discounted at the rate of ten per cent and then added to the short term loan total.

The decisions and environment section of the Financial Status Sheet displays some of the decisions made by the company some of the effects of those decisions, and some other information that the company may desire to know.

The remarks section is utilized to print penalty statements which are to inform the company that it has attempted to violate the rules of the simulation, and provides a space for the growth of the Financial Status Sheet if future development of the model so warrants.

# CHAPTER V

## INSTRUCTIONS TO CONDUCT THE SIMULATION

### Introduction

The purpose of the oil industry model, as stated in the title of this thesis, is to provide instructors with an engineering-management training aid. In order for it to accomplish its purpose, instructions must be written to guide both the student and the instructor, the model administrator, in the procedures recommended to conduct the simulation. This is the purpose of this chapter.

The first part of the chapter is entitled The Student's Pamphlet and contains a brief description of the model, the recommended procedures to follow during the simulation, a list of decisions to be made, a description of the format of the decision cards and their arrangement, and a decision work sheet. Each student should be provided with a pamphlet far enough in advance of the start of the simulation that he may have the opportunity to familiarize himself with its contents.

The second part of the chapter is entitled The Model Administrator's Pamphlet and includes instructions for assigning parameters, suggestions for tailoring the model, descriptions of the arrangement and format of the parameters, suggested values for the parameters, the arrangement of the final deck, and the recommended procedures to conduct the simulation. Each model administrator should have one of these pamphlets to refer to during the simulation, however, this thesis should be his primary source for information concerning the model if a problem develops and the solution is not apparent.

# The Student's Pamphlet

## Model Description

The computor model, Paydirt, is programed in Fortran IV programming language. It is a simulation of an industry of independent oil companies that buy and sell oil property leases; revert, develop, or abandon the leases they have bought; buy and sell stock of their own company; and invest in companies outside the industry. As presently programed, the number of companies in the industry is limited to five.

Whenever oil property leases are bought and sold, a bonus is normally paid to the leasing party to obtain the lease. The leasing party will usually lease to the company offering the highest bonus. When bids for leases are made, the bids are not to purchase the oil property, but the bids are made for the right to lease the property. Bids may be for any amount above the minimum bid which is disclosed on the lease description. The program will pick out the highest bid and award the lease to the company that made that bid. Should two companies make the same bid, and that bid is the high bid, the winner of the bid will be picked by random selection. A bid will not be recognized by the program if the lease is not on the list of available leases for sale by the model administrator, or if the lease is not offered for sale by another company.

Companies may sell leases to other companies at any time as long as the company owns the lease it is attempting to sell. The sale between two companies may be a private deal, or a company desiring to sell a lease may make that fact and the acceptable minimum bid known to the other companies. When a company desires to sell, the number of the lease being sold is punched into the first lease bid card with a minus sign before the number in the

proper format. The minimum bid desired is punched in the corresponding field on the second bid card in the proper format. Companies will be penalized for attempting to sell leases that they do not own.

If a company buys a lease and drills a dry hole on it, it is recommended that the company revert the lease as soon as possible. If it is not reverted, the program may charge a company a delay rental charge for the time the lease is held. Only leases without producing wells may be reverted.

Abandonment of a lease should occur only when the lease has been depleted to the point where it is no longer economical to produce oil or gas from it. Companies may abandon a lease at any time, however, when a lease is abandoned, it removes the lease completely from circulation and the abandoning company is charged a fee per well for abandoning. The fee simulates the closing in of the wells, removing equipment from the lease, and restoring the surface of the lease to some reasonable condition. Companies are warned not to attempt to abandon a lease they do not own.

The first step in developing an unproven lease that a company has acquired is to drill an exploratory well. The exploratory well will be the first well to be drilled on any unproven lease. Once the exploratory well shows that oil has been found, or the lease acquired already has producing wells on it, development wells may be drilled at the rate of four wells per month until a well is a dry hole. All wells drilled on a lease, after a dry hole has been drilled on the lease, will also be dry. If during a simulated time period a well on a lease is a dry hole, the program will drill no more wells. Also, a dry hole drilled on a producing lease is an indication that the limit of producing wells has been reached.

When a producing well has been drilled, the well is assigned a well factor which determines the rate of production of the well. A maximum rate of oil production is calculated and multiplied times the well factor of each well on the lease to determine each well's production for the month. This production is summed to find the total production of the lease for the month. The production of oil may be limited by an oil allowable. A producing gas-oil ratio is also calculated and multiplied times the oil produced to calculate the gas production from the lease. A gas allowable may also limit the production of oil from the lease. Companies have no control over the production of oil and gas from the leases they own.

Should a lease not produce at the desired rate, the owning company may do any of the following procedures to imporve well performance: (1) they may fracture the wells on the lease, (2) they may acid treat the wells on the lease, (3) they may install pumps on the lease, or (4) they may install a secondary recovery system on the lease. Wells may be fractured and/or acid treated at any time but only the original attempt of each treatment may be successful during the life of the well. These treatments will not be successful once pumps have been installed on the wells. Pumps must be installed on a lease before secondary recovery can be installed, and neither can be installed until the maximum production per well is less than the oil allowable. If a company attempts to install pumps or secondary recovery prematurely, the program will ignore these attempts.

As oil and gas are produced on a lease the equipment necessary for production grows old and wears out, and the operating and maintenance costs increase. These costs are the variable costs of operating the

lease, and the companies may reduce these costs by investing in new equipment.

There are many other costs involved in the program. Charges are made for drilling wells, fracturing and acid treating wells, and installing pumps and secondary recovery systems. Administrative costs are determined by multiplying a per cent times the total assets of a company. These administrative costs may be reduced by investing in operations research. Royalties are also paid by the companies to the land or royalty owners. Delay rental charges are made against a company if they do not drill on the lease within one year after purchase of the lease. As another cost, interest is paid on all outstanding loans and bonds that a company is liable for. All costs that can be capitalized, are capitalized as tangible or intangible assets. The tangible assets are reduced by depreciation, and the intangible assets are reduced by depletion.

Depreciation and depletion is computed for each lease and added to determine the total amount allowed to a company. Companies may choose the method of computing depreciation: method number one is the straight line method, method number two is the double declining balance method, and method number three is the sum-of-the-years digits method. When switching depreciation methods; the rule of present tax laws must be followed. Companies have no choice in the method used in computing depletion. The amount of depletion deduction will be the maximum amount allowed.

At the beginning of the simulation, all companies will be given the same amount of assets and liabilities. They will be identically distributed, i.e. each company will have the same amount of cash, the same amount of accounts receivable, the same amount of accounts payable,

the same amount of paid in capital, etc. Should a company need more capital to cover its costs, it may acquire extra capital by borrowing a short term loan, by selling bonds, and by selling company stock. If a company decides that it has too much cash on hand, it may invest the cash in other domestic companies outside the industry and receive dividends from the investment, or the company may invest in its own stock, thereby saving on the dividends that must be paid to its stockholders.

If a company runs out of cash during their transactions, the company is required to take an emergency loan to complete their transactions. The emergency loan is automatically discounted at the rate of ten per cent and is then added to the short term loan total.

A market quote is computed for each company to indicate how well the company is doing and to establish a price for the buying and selling of the stock of the company. This quote is based upon the trend of the change in the book value of the stockholder's equity due to operations and upon the amount of the dividends paid by a company.

The model provides each company with three reports: (1) a lease development report, (2) a lease production and cost report, and a company financial status sheet. These reports are to provide a picture of how the company fared as a result of the decisions it had previously made.

## Recommended Procedures

The following procedure in making company decisions is recommended:

1. Companies should read through the lease descriptions and analyze them to determine what the chance might be of finding oil under each unproven lease and to estimate if the asking price is worth the chance.

For producing leases, the companies should attempt to determine if the lease will provide a favorable return on the money required to be invested.

2. Once the decision has been made as to which leases are to be bid upon and how much is to be bid, companies should elect a method of depreciation for tangible assets even though they do not know who will be the owner of the lease.

3. It is advisable for companies to request to drill on the leases that they have bid upon. This is assuming that the company has the funds to cover the costs of these requests.

4. Companies should estimate the capital necessary to accomplish the transactions they are requesting, and request extra capital if their estimates show that they do not have enough. Likewise, if companies believe that they have too much capital on hand, they should invest the extra capital.

5. Companies should determine how much fringe benefits they would like to pay their employees in order to avoid a strike. Also, if there is no labor contract in force, companies should decide the wage rate they would like to pay their employees.

6. The stockholders would like their share of the profits, so the companies should decide how large a dividend they can afford to pay. The amount decided upon should be for a quarter of a year.

7. If administrative expenses are too high, companies should decide how much money to invest in operations research.

8. Companies should analyze the production from their producing leases and attempt to determine if it is desirable to fracture or acid treat the wells of a lease, install pumps or secondary recovery on the lease, or abandon the lease.

9. A check should be made to determine the trend of the operating costs of each lease. If they appear to be getting too high, a decision should be made as to how much money should be invested in new equipment for the lease if any.

Preparation of the Decision Deck

The first decision card of the decision deck contains the request for the amount of dividends to be paid to the stockholders, the request for a short term loan, the request for a long term loan in the form of a bond sale, the request to invest in outside domestic companies, the request to buy or sell it's own stock, the request for a wage rate per hour to be paid to the company employees, the request to invest in operations research, and the request for the fringe benefit rate per hour to be paid to the company employees.

The second decision card to be prepared is the card containing the lease numbers of the leases the company is bidding for. The format for this and all of the other decision cards is indicated on the diagram of the arrangement of the decision deck on the following page. The next card should contain the amount bid for each lease punched in the field corresponding to the field in the second card where the lease number is located.

The decisions to revert or abandon leases are punched in the fourth decision card. The first four fields should contain the lease numbers of the leases to be reverted and the last four fields should contain the lease numbers of the leases that are to be abandoned.

The next two cards of the decision deck are for equipment renewal. The first card contains the lease numbers of the leases on which it is

## Company Decision Deck

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1st lease number | 2nd lease number | 3rd lease number | 4th lease number | 1st lease number | 2nd lease number | 3rd lease number | 4th lease number |

PUMP INSTALLATION REQUESTS — SECONDARY RECOVERY INSTALLATION REQUESTS
FORMAT (8F10.0)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1st lease number | 2nd lease number | 3rd lease number | 4th lease number | 1st lease number | 2nd lease number | 3rd lease number | 4th lease number |

FRACTURE REQUESTS — ACID TREATMENT REQUESTS
FORMAT (8F10.0)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| number of wells | number of wells | number of wells | number of wells | number of wells | number of wells | number of wells | number of wells |

NUMBER OF WELLS TO BE DRILLED
FORMAT (8F10.0)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1st lease number | 2nd lease number | 3rd lease number | 4th lease number | 5th lease number | 6th lease number | 7th lease number | 8th lease number |

LEASE NUMBERS OF LEASES ON WHICH WELLS ARE TO BE DRILLED
FORMAT (8F10.0)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| method number | method number | method number | method number | method number | method number | method number | method number |

METHOD BY WHICH DEPRECIATION IS TO BE COMPUTED
FORMAT (10I8)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1st lease number | 2nd lease number | 3rd lease number | 4th lease number | 5th lease number | 6th lease number | 7th lease number | 8th lease number |

LEASE NUMBER ON WHICH DEPRECIATION METHOD IS TO BE CHANGED OR INITIALIZED
FORMAT (10I8)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| amount invested | amount invested | amount invested | amount invested | amount invested | amount invested | amount invested | amount invested |

AMOUNT INVESTED IN EQUIPMENT RENEWAL
FORMAT (8F10.2)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1st lease number | 2nd lease number | 3rd lease number | 4th lease number | 5th lease number | 6th lease number | 7th lease number | 8th lease number |

LEASE NUMBERS OF LEASES ON WHICH EQUIPMENT IS TO BE RENEWED
FORMAT (8F10.2)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1st lease number | 2nd lease number | 3rd lease number | 4th lease number | 1st lease number | 2nd lease number | 3rd lease number | 4th lease number |

REVERSION REQUESTS — ABANDONMENT REQUESTS
FORMAT (8F10.2)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| amount bid | amount bid | amount bid | amount bid | amount bid | amount bid | amount bid | amount bid |

AMOUNTS BID FOR LEASES
FORMAT (8F10.2)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1st lease number | 2nd lease number | 3rd lease number | 4th lease number | 5th lease number | 6th lease number | 7th lease number | 8th lease number |

LEASE NUMBERS OF LEASES FOR WHICH THE COMPANY IS BIDDING
FORMAT (8F10.2)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DIVIDEND PAYMENT REQUEST | SHORT TERM LOAN REQUEST | BOND REQUEST | INVESTMENT REQUEST | SHARES TO BUY OR SELL | LABOR WAGE RATE REQUEST | OPERATIONS RESEARCH REQUEST | FRINGE BENEFIT REQUEST |

FORMAT (8F10.2)

desired to renew equipment. The next contains the amount of funds a company desires to invest in new equipment for the leases whose lease numbers are punched in the corresponding fields of the first card.

The election of depreciation methods are punched in the next two cards. The lease numbers for which the election is made is punched in the first card, and the method number is punched in the corresponding field of the second card.

The next two cards should contain the request to drill. Again, the first card contains the lease numbers of the leases on which it is desired to drill. The second card should contain the number of wells the company wishes to drill on the leases whose lease numbers are punched in the corresponding fields of the first card.

The next card contains the requests to fracture or acid treat the wells of a lease. The first four fields of the card should contain the lease numbers of the leases on which the wells are to be fractured. The last four fields contain the lease numbers of the leases on which the wells are to be acid treated.

The last card of the decision deck contains the decisions to install pumps or a secondary recovery system on leases on which it is desired to install pumps. The last four fields should contain the lease numbers of the leases upon which it is desired to install a secondary recovery system.

The cards of the decision deck will be arranged in the order described here, and illustrated on the previous page.

On the following page is an example of the work sheet on which to make the decisions. These will be provided to each of the companies.

Card No. Decision Work Sheet for Company Number ____ For the Period Beginning with Month ___ of Year ____.

| Card No. | DIVIDEND PAYMENT (QUARTERLY) | SHORT TERM LOAN ((-) REPAY) | BONDS | INVESTMENT ((-)DISINVEST) | SHARES (+) BUY (-) SELL | LABOR WAGE RATE | OPERATIONS RESEARCH | FRINGE BENEFIT |
|---|---|---|---|---|---|---|---|---|
| I. | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| II. | Lease numbers for leases bid upon. | | | | | | | | |
| III. | Amount bid for leases. | | | | | | | | |
| IV. | Lease numbers for leases reverted. | | | | | Lease numbers for leases abandoned. | | | |
| V. | Lease numbers for equip. renewal. | | | | | | | | |
| VI. | Amount invested. | | | | | | | | |
| VII. | Lease numbers for deprec. change. | | | | | | | | |
| VIII. | Depreciation method. | | | | | | | | |
| IX. | Lease numbers for wells to drill. | | | | | | | | |
| X. | Number of wells to be drilled. | | | | | | | | |
| XI. | Lease numbers for fracturing. | | | | | Lease numbers for acid treating. | | | |
| XII. | Lease numbers for pumps installed. | | | | | Lease numbers for sec. recovery installed. | | | |

Parameter List for Company Information

1. The length of the simulated time period in months. . .
2. The maximum number of leases a company may own. . . .
3. Penalty for attempting to beat the model. . . . . . .
4. The selling price of oil per stock tank barrel. . . .
5. The selling price of gas per thousand cubic feet. . .
6. The abandonment costs per well. . . . . . . . . . . .
7. The federal tax rate. . . . . . . . . . . . . . . . .
8. The state severance tax rate. . . . . . . . . . . . .
9. The bond interest rate. . . . . . . . . . . . . . . .
10. The short term loan interest rate. . . . . . . . . .
11. The royalties paid as a per cent of gross revenue. . .
12. The outside investment dividend rate. . . . . . . . .
13. The tangible costs of drilling a producing well. . . .
14. The intangible costs of drilling a producing well. . .
15. The costs per well of fracturing. . . . . . . . . . .
16. The costs per well of acid treating. . . . . . . . . .
17. The costs per well of installing pumps. . . . . . . .
18. The costs per well of installing secondary recovery. .
19. The costs of drilling a dry hole. . . . . . . . . . .
20. The oil production allowance per well per month. . . .
21. The gas production allowance per well per month. . . .

On the second page following, is a list of the parameters that are set by the model administrator and that may be provided to the companies at the discretion of the administrator. The values that the administrator desires to provide the companies with will be indicated in the column as labeled.

## The Model Administrator's Pamphlet

### Introduction

The Model Administrator's Pamphlet is basically a guide for the use of the administrator in the execution of the engineering-management simulation, Paydirt. It provides him with instructions for assigning parameters, procedures to conduct the simulation, methods that may be used to tailor the model, and recommendations for parameter values. The administrator's main source of information is the thesis, "Paydirt, A Simulation of an Industry of Independent Oil Companies for Use as an Engineering-Management Aid."

### Assigning Parameters

Parameters have been defined to be those attribute values which do not change during the simulation.[25] They need to be assigned only once, at the beginning of the simulation. If the parameters are changed during the simulation, the companies should be told of the change. Also, even though the definition states that they should not be changed, it is advisible to change the parameters if it is found that the model is not reacting as expected possibly because poor values were picked to begin with. It may be desired to change some of the parameters to simulate certain conditions within the simulation such as having the labor contract

terminate, or having fluctuating gas and oil allowables. Parameters should be chosen with care in order that the model be kept as realistic as possible. There is a list of parameters, their definitions, and some recommended values on the following page. Further discussion of assigning parameters will be included in the section on tailoring the model. Initial values have been assigned in the starting deck provided.

Instructions for the Execution of the Simulation

This model is designed to provide instructors with an additional method of instructing their students in the use of engineering and financial tools and to help them to analyze data and make decisions based upon that analysis. It has been the aim of the author to construct the model in order that the administrator (the instructor) will have to do as little of the mechanics as possible. There are, however, a few tasks to be performed.

The administrator will need copies of the initial starting point Financial Status Sheet, a list of leases available for sale, and a sample Lease Report to distribute to the students. These can be obtained by assigning a period length of zero and the number of copies desired for each company in the proper fields in the second card of the starting deck provided, and submitting the program to be run on the computer. Do not forget to change the period length before starting the first simulated period.

Before the first meeting with the students, the administrator should have an ample supply of Student's Pamphlets, with the parameter list filled in, and Decision Worksheets. These along with the sample output described above should be distributed at the first meeting. The

## List of Parameters

| VARIABLE NAME | RECOMMENDED VALUE | DESCRIPTION |
|---|---|---|
| ABDNFT | 2000.00 | The cost per well of abandoning a lease. |
| ACDCOS | 2000.00 | The cost of acid treating one well. |
| ACDFAC | 0.15 | The chance that an acid treatment will not effect a well's performance. |
| ACFLOW | 1.30 | The factor to increase production for a successful acid treatment of a well. |
| BDRATE | 0.05 | The rate of interest on bonds. |
| BENBAS | 0.20 | The basic benefit rate. |
| BENFIT | (start).20 | The factor to control the option of having companies vary fringe benefits. |
| CASHFT | 0.50 | The portion of a collection or payment that will affect the cash account. |
| DECLN | 0.90 | The factor to change the rate of decline after a well has be treated. |
| DIVBAS | 1.00 | The basic quarterly dividend rate. |
| DRINTG | 12000.00 | The amount of drilling cost assigned as an intangible asset. |
| DRTANG | 7000.00 | The amount of drilling cost assigned as a tangible asset. |
| DRYHCS | 13000.00 | The cost of drilling a dry hole. |
| DVRATE | 0.02 | The dividends received as a percent of the total outside investment. |
| EQCSFT | 0.60 | The fraction of the cost of a producing lease that is assigned as equipment cost. |
| FINE | 5000.00 | The penalty fine attempting to break the rules of the simulation. |
| FRCCOS | 4000.00 | The cost to fracture one well. |
| FRCFAC | 0.15 | The chance that a fracture job will not affect well production. |

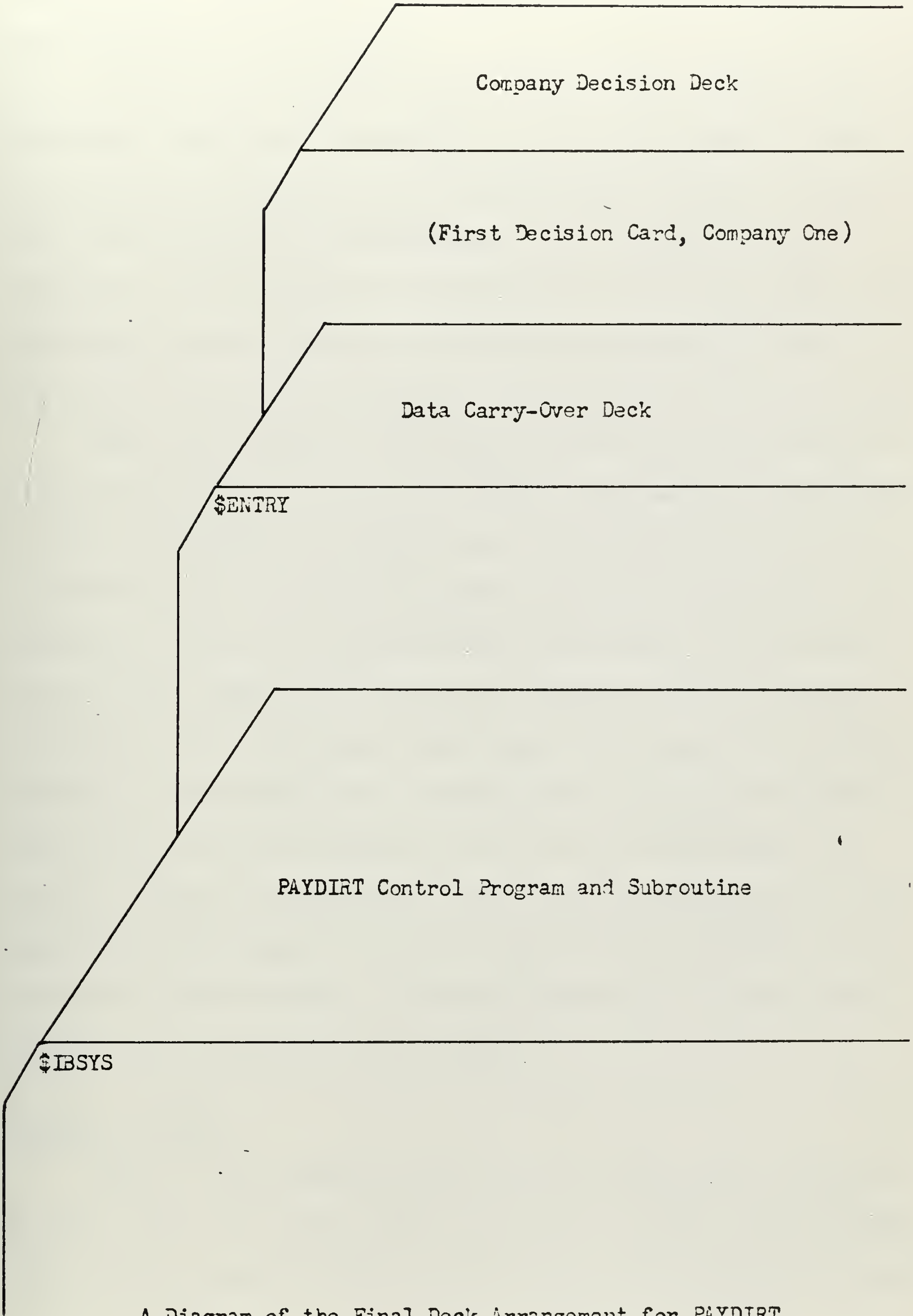
| | | |
|---|---|---|
| FRFLOW | 1.50 | The factor to increase production for a successful fracturing of a well. |
| FTAXR | 0.48 | The federal income tax rate. |
| GASALW | 8000.00 | The allowable production of gas from a well per month in MSCF. |
| GPRICE | 0.16 | The price of natural gas per MSCF. |
| MAXOWN | 20 | The maximum number of leases a company may own at any one time (limited to twenty). |
| NPLAY | 5 | The number of companies taking part in the simulation (limited to five). |
| OILALW | 1500.00 | The allowable production of oil from a well per month in barrels. |
| OPRICE | 3.00 | The selling price of oil per barrel. |
| ORBASE | 400,000.00 | The base amount to be invested in operations research. |
| PAYBAS | 3.00 | The base pay rate to be paid to company employees. |
| PMFLOW | 3.00 | The factor to increase production because pumps were installed on the lease. |
| PMPCOS | 8000.00 | The cost of installing a pump on one well. |
| QUOTFT | .50 | The factor to vary the sensitivity of the market quote. |
| RLABOR | 3.00 | The factor to control the option to allow companies to vary their pay rates for employees. |
| ROYL | 0.125 | The royalties paid as a per cent of gross revenues. |
| SECCOS | 10,000.00 | The cost of installing a secondary recovery system per well. |
| SRFLOW | 4.00 | The factor to increase production due to the installation of a secondary recovery system. |
| STAXR | 0.02 | The state severance tax rate. |
| STKFAC | 0.50 | The factor to vary the sensitivity of a strike. |

| | | |
|---|---|---|
| STRATE | 0.12 | The short term loan interest rate. |
| TERMSP | 12.00 | The period of time in months that all accounts payable will be paid if no more are acquired. |
| TERMSR | 12.00 | The period of time in months that all accounts receivable will be collected if no more are acquired. |
| VARCOS | 0.15 | The base variable cost factor to produce one barrel of oil. |

students should be given sufficient time to become familiar with the material and have a chance to discuss it before they are required to start making decisions.

When it is time to start the simulation with the first time period run, the administrator has the choice of having the companies key punch their own decision decks, or of having the companies submit their Decision Worksheets to him for him or his assistant to key punch. If the administrator's choice is the first one, he should be particularily careful that the cards have been punched in the correct format. When assembling the deck for submission, care should be taken to organize it in the correct order. There is a diagram of the correct order for the arrangement of the deck on the following page. Also, the correct control cards for the computor system should be used to properly compile and run a Fortran IV source deck. Binary decks may be obtained to avoid the compilation time that is necessary with the source deck.

Administrators are advised to start the simulation with a time period length of one month for the first two or three runs. After these first runs, it is recommended that the period lengths be increased to quarters and then to half years and then to years. The pace and amount of the increases will depend upon the students adaptation to the simulation. When dividing the students into companies, the administrator should be careful to insure that the special talent, i.e. the better engineers or the better financial managers, is spread among the companies. Also, it is advisable to start the simulation with a labor contract in force (RLABOR assigned the same value as PAYBAS and BENFIT assigned the same value as BENBAS). The result will be that the companies will not suffer




A Diagram of the Final Deck Arrangement for PAYDIRT.

a strike in the early months of the simulation at the time when they are getting acquainted with the model.

To encourage participation and interest in the simulation, the administrator should make the simulation a part of the student's grade for the course it is being used for, and also, set a standard for picking a winner at the end of the simulation. This standard may be a combination of factors from the Financial Status Sheet such as the market quote, the book value of the stockholder's equity, the debt/equity ratio, etc., and should be set at the beginning of the simulation.

There are no apparent end effects connected with the simulation, however, this may not be true and can only be proven true with experience. To avoid any end effects that might occur, it is recommended that two or more decision decks be run simultaneously. This can be accomplished by changing the value on the variable NDECKS to the number of the decision decks to be run. NDECKS is the third bit of data on the first card of the carryover deck. The decision decks should be arranged back to back at the end of the complete deck. Another method to use to prevent end effects is to run the same decision deck through two simultaneous time periods. This may be accomplished by duplicating the decision deck, putting the duplicate behind the original deck, and changing NDECKS to two. With either of these methods, any radical decisions by a company would probably do that company more harm than good.

<u>Tailoring the Model</u>

There are some margins within which the administrator can tailor the model to fit the specific result that he may want from that simulation. There are three methods by which the tailoring of the model can be achieved:

(1) the values assigned to the parameters, (2) the values assigned to the data deck, and (3) the cancellation of the companies right to make certain decisions.

There are a number of variations that can be obtained by setting certain values for the parameters at the beginning of the simulation or during the simulation. If the administrator does not agree with the penalty aspect of the model, he may set this parameter equal to zero and completely eliminate it. The message concerning the attempted violation will still be printed on the company's Financial Status Sheet. If the administrator is not in accord with the strike feature of the model, he may set the strike sensitivity factor equal to zero and eliminate it. The degree of sensitivity of the strike feature can be altered by varying the strike sensitivity factor between zero and one. To allow the companies to vary employee wages and fringe benefits, the parameters RLABOR and BENFIT are set equal to zero. This permits the companies to vary wages within ten per cent of the base wage, and fringe benefit rates from zero to twice the basic benefit rate. This condition has been termed as no labor contract in force.

The changes to be made during the simulation include the changing of the price of oil and gas to simulate seasonal variations, the variation of interest rates which would change the future value of money, and the variation of tax rates to simulate changes in government policy. As experience with the model is obtained, new ideas for changes will be apparent.

The model may be tailored by arranging the values in the initial starting deck. If it is desired that the competition for leases be eliminated, certain leases may be picked and the same lease may be assigned to all of

the companies but under different numbers. If it is desired that the chance of drilling a dry hole be eliminated, the geological factors may be made equal to one and every lease will be a producing lease.

The disallowing of decisions is another method of tailoring the model. If the administrator decides to stress engineering, he may do so by not allowing financial decisions to be made. Even the bidding may be eliminated by assigning leases to companies. The control of the administrator would be to check the decision deck before submitting it to insure that the decisions that are disallowed are not read in.

## CHAPTER VI

## CONCLUSION AND RECOMMENDATIONS

### Conclusion

Paydirt is a model constructed to simulate independent oil companies and their operations. It is, at best, a crude simulation, for not only were the activities of the company itself modeled, but it was necessary to attempt to model oil reservoirs that have an inherent wealth of uncertainty. Even though it is described as being crude, it is operable as a simulation and does reflect many of the characteristics of the events associated with oil companies. As described in the previous chapter, the model is flexible enough to allow general or restricted operations of oil companies to be simulated.

### Recommendations

At the beginning of this thesis, it was stated that the construction of any entity required some necessary groundwork or foundation. Now that the model is constructed, it is felt that it may be thought of as a foundation for future development of the simulation of the oil industry. There may never be a final model. As computor technology is increased and more knowledge of the simulation of events is obtained, the simulation of the industry will continually be improved if properly pursued. The future models may not only be used for training, but they may also be used to study the effects that changes in environment will have on the oil industry. Examples of these environmental changes might be the change

in policy of importation of oil and natural gas, the increased use of liquified natural gas, the advent of new types of automobile engines, the arrival of supersonic jet travel, and many others. These events may seem farfetched at this point, but they will affect the production of oil from the reservoir through the demand for petroleum products. The next steps to be taken are recommended as follows:

1. A further study should be made of the costs involved in the exploration and development of oil leases and of the manner in which these costs are allocated to revenues.

2. An attempt is needed to provide a better model of different types of oil and gas reservoirs including compatible reservoir characteristics.

3. Further work is required on the model, Paydirt, in order that it could include simulations of transportation, refining, and the marketing aspects of the industry.

Although it is felt that Paydirt is a complete working model, there is much to be done before it will be comprehensive enough to achieve its full potential.

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## REFERENCES


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19. <u>Ibid</u>., p. 3201.

20. <u>Ibid</u>., p. 1619, 3201.

21. Campbell. op. cit., p. 98.

22. <u>Ibid</u>.

23. Dyckman. <u>op</u>. <u>cit</u>., pp. 3110-3111.

24. <u>Ibid</u>., p. 3202.

25. Gonzales. <u>op</u>. <u>cit</u>., p. 21.

LEASE DESCRIPTIONS

Lease Number 2 Acreage 1300

Romero's Ranch Lease

Area Description: This land is rocky and sandy and supports very little foliage growth. The area receives sparce annual rainfall and consequently is not used as pasture by the owner. The lease is the southwestern section of a 3500 acre ranch.

Geological Data: No geological studies or analysis have been made of the lease. Area magnetic surveys have indicated that a favorable sedimentary basin exists in this area, but no favorable structures can be detected from the outcroppings.

Drilling History: There is no record of any drilling having been performed on this lease. A portion of a ranch about 25 miles west of the lease was developed about a year and a half ago. The wells were drilled to a depth of approximately 4000 feet and are presently averaging about thirty barrels a day with ten per cent water.

Terms: Mr. Romero will accept no less than seventy-seven cents per acre as a bonus for the leasing rights. The Lessee must begin drilling within one year or be liable for a delay rental payment of one dollar per acre per year. The lease will be automatically terminated at the end of five years or when it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

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Lease Number 3 Acreage 1995

Barclay Farms Lease

Area Description: The land in the area of the lease is rich rolling farm land used to grow soy beans and corn. The surface elevation is about 1000 feet above sea level, and the area is dotted with lakes and ponds.

Geological Data: There is no geological data available to analyze. Seismic readings were taken on a farm about ten miles northeast of this lease and indicated that an unconformity existed at a depth of approximately 3500 feet. Also there was a possible porous layer at a depth of about 4600 feet.

Drilling History: There has been no drilling on this lease. A well was drilled on the lease mentioned above to a depth of about 5000 feet, and was considered a duster.

Terms: The owner will accept the highest bid offered, but it must be at least one dollar per acre. The Lessee will also be liable for unnecessary damage to crops or livestock. The Lessee must begin drilling within one year or he must pay the lessor one dollar per acre per year until drilling does commence. The lease will be terminated at the end of five years automatically if drilling has not begun or when it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

Lease Number 4 Acreage 1650

Past Lease Production Time: 3 months

| | |
|---|---|
| Producing Formation: | Queen (sand) |
| Average Producing Depth: | 3040 ft. |
| Oil Wells: | |
| Currently being produced: | |
| Flowing: | 9. |
| Pumping: | 0. |
| Gas Lift: | 0. |
| Wells that have produced oil: | |
| Shut in: | 0. |
| Plugged and abandoned: | 0. |
| Converted to gas wells: | 0. |
| Gas Wells: | |
| Producing: | 0. |
| Shut in: | 0. |
| Dry and abandoned: | 0. |
| Total wells drilled: | 9. |
| Production to date: | |
| Oil Production: | 7500. |
| Water Production: | 750. |
| Gas Production: | |
| Gas produced from oil: | 2835. (MSCF) |
| Dry Gas: | |
| Total gas produced: | 2835. |
| Reservoir Data: | |
| Initial reservoir pressure: | 2361. |
| Present estimated reservoir pressure: | 2300. |
| Saturation pressure: | 2300. |
| Oil A.P.I. gravity: | 38° |
| Sulphur percentage: | 1.07 |
| Royalty Interest: | |
| Owner: | 12.5% |
| Other: | 0 |

Undepreciated tangible assets on lease: not available at this time.

Estimated Reserves: 800,000.

Minimum Bid: $1,500,000.

Lease Number 5 Acreage 1112

Past Lease Production Time: 9 Months

Producing Formation: Montoya
Average Producing Depth: 7000. ft.

Oil Wells:
- Currently being produced:
  - Flowing: 11.
  - Pumping: 0.
  - Gas Lift: 0.
- Wells that have produced oil:
  - Shut in:
  - Plugged and abandoned: 0.
  - Converted to gas wells: 0.

Gas Wells:
- Producing: 0.
- Shut in: 0.

Dry and abandoned: 2.
Total wells drilled: 13.

Production to date:
- Oil Production: 103,000.
- Water Production: 0.
- Gas Production:
  - Gas produced from oil: 73,170. (MSCF)
  - Dry Gas: 0.
  - Total gas produced: 73,170.

Reservoir Data:
- Initial reservoir pressure: 3650.
- Present estimated reservoir pressure: 3595.
- Saturation pressure: 3600.

Oil A.P.I. gravity: 40.3°
Sulphur percentage: .34

Royalty Interest:
- Owner: 12.5%
- Other: 0.0

Undepreciated tangible assets on lease: Not available at this time.

Estimated Reserves: 500,000.

Minimum Bid: $945,000.

Lease Number 6 Acreage 2152

Bell's Farm Lease

Area Description: This lease is a tract of fairly level farm land that averages about 500 feet above sea level. It is located in a large valley surrounded by low mountain ridges. There is a moderate size stream that winds down the middle of the valley and cuts across the southwest section of the lease. The roads to and in the area are excellent.

Geological Data: No surveys have been done on this lease to date. Seismic readings were taken on an adjacent lease in January of 1966 which indicated that a dome structure exists under that lease. This has proven to be correct by several exploratory wells that have been drilled on that lease. From the information received it is believed that the structure extends under this lease also. The producing formation appears to be the Seven Rivers (sand).

Drilling History: There is no history of drilling on this lease that can be found. The wells on the adjacent lease are producing from about 2500 feet and are flowing enough to easily make their allowable.

Terms: Mr. Bell will consider no less than five dollars an acre as a bonus for leasing. Drilling is to commence within one year or the lessor will pay the lessee the amount of one dollar per acre per year as a delay rental payment. The lease will be terminated at the end of five years or when it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

---

Lease Number 7 Acreage 1222

Hillsdale-Valley Farm Lease

Area Description: This area, including the lease, is slightly rolling farm land used primarily to grow corn and wheat. There is plenty of water in the area and the roads to and in the area are excellent.

Geological Data: None.

Drilling History: There is no record of any drilling having been performed on this lease.

Terms: Because it is excellent farming land, the owner will consider no less than one dollar an acre for a bonus to lease. Drilling will commence within one year or the lessee will pay the lessor a delay rental payment of one dollar per year per acre. The lease will terminate at the end of five years or when it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

Lease Number 8 Acreage 5000

Renold's Ranch Lease

Area Description: The area is rolling open range in western Kansas, used for cattle grazing. Except for a few ponds on the ranch, there is no available source of water. Roads into the area are gravel roads in good condition most of the year.

Geological Data: There are very limited rock outcroppings visible on the lease. Aerial photography shows that there is a little evidence of the presence of faults in the northeastern section and the possible beginning of an anticline structure in the southern portion. A recent inspection revealed two possible oil seeps in the area of the faults.

Drilling History: No drilling has been done on this lease that can be determined. A wildcat well was drilled on a lease about thirty miles west of this lease to a depth of about 4000 feet. It was considered a duster.

Terms: The owner will consider bids of twenty cents an acre or better as a bonus for the lease. Drilling is to commence within one year or a delay rental must be paid by the lessee to the lessor of one dollar per acre per year. The lease will be terminated at the end of five years or when it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

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Lease Number 9 Acreage 1311

Blue Marsh Leash

Area Description: The area is generally flat and marshy land with an elevation right at sea level. No farming is done in this area because of the marshy nature of the land. There are a few roads but transportation is mainly by boat.

Geological Data: There is a scarcity of geological information for this area, however, the region is becoming famous for its many salt domes. An aerial magnetic survey of this area was made in 1962 which indicated that a dome may exist in the vicinity of the lease. Seismic readings have not been taken to confirm or deny this indication.

Drilling History: There is no evidence of past drilling on this or adjacent leases.

Terms: The owners will consider no less than one dollar per acre bonus for this lease and will lease to the highest bidder. Drilling is to commence within one year or a delay rental of one dollar per acre per year must be paid to the lessor by the lessee. The lease will be terminated at the end of five years or when it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

Lease Number 10 Acreage 760

| | |
|---|---|
| Past Lease Production Time: | 7 Years |
| Producing Formation: | Deleware |
| Average Producing Depth: | 1960 ft. |

| | | | |
|---|---|---|---|
| Oil Wells: | | | |
| Currently being produced: | | | |
| Flowing: | 0. | | |
| Pumping: | 2. | | |
| Gas Lift: | 0. | | |
| Wells that have produced oil: | | | |
| Shut in: | 0. | | |
| Plugged and abandoned: | 2. | | |
| Converted to gas wells: | 0. | | |
| Gas Wells: | | | |
| Producing: | 0. | | |
| Shut in: | 0. | | |
| Dry and abandoned: | 1. | | |
| Total wells drilled: | 5. | | |
| Production to date: | | | |
| Oil Production: | | 7,500. | |
| Water Production: | | 0. | |
| Gas Production: | | | |
| Gas produced from oil: | | 830. | (MSCF) |
| Dry Gas: | | 0. | |
| Total gas produced: | | 830. | |
| Reservoir Data: | | | |
| Initial reservoir pressure: | | 1500. | |
| Present estimated reservoir pressure: | | | |
| Saturation pressure: | | 2300. | |
| Oil A.P.I. gravity: | | 29° | |
| Sulphur percentage: | | 0. | |
| Royalty Interest: | | | |
| Owner: | | 12.5% | |
| Other: | | 0.0 | |
| Undepreciated tangible assets on lease: | | none | |
| Estimated Reserves: | | 10,000. | |
| Minimum Bid: | | $5,000. | |

Lease Number 11 Acreage 2000

| | | |
|---|---|---|
| Past Lease Production Time: | 1 month | |
| Producing Formation: | Yates | |
| Average Producing Depth: | 1300. ft. | |
| Oil Wells: | | |
| Currently being produced: | | |
| Flowing: | 1. | 12 BPD |
| Pumping: | 0. | |
| Gas Lift: | 0. | |
| Wells that have produced oil: | | |
| Shut in: | 0. | |
| Plugged and abandoned: | 0. | |
| Converted to gas wells: | 0. | |
| Gas Wells: | | |
| Producing: | 0. | |
| Shut in: | 0. | |
| Dry and abandoned: | 0. | |
| Total wells drilled: | 1. | |
| Production to date: | | |
| Oil Production: | 400. | |
| Water Production: | 0. | |
| Gas Production: | [illegible] | [illegible] |
| Gas produced from oil: | 122. | (MSCF) |
| Dry Gas: | 0. | |
| Total gas produced: | 122. | |
| Reservoir Data: | | |
| Initial reservoir pressure: | | 2149. |
| Present estimated reservoir pressure: | | 2140. |
| Saturation pressure: | | 2000. |
| Oil A.P.I. gravity: | | 41° |
| Sulphur percentage: | | 1.3 |
| Royalty Interest: | | |
| Owner: | | 12.5% |
| Other: | | 0 |
| Undepreciated tangible assets on lease: | not available | |
| Estimated Reserves: | | 50,000. |
| Minimum Bid: | | $100,000. |

Lease Number 12 Acreage 3100

| | | |
|---|---|---|
| Past Lease Production Time: | 9 Months | |
| Producing Formation: | Blinebry (Yeso-Lime) | |
| Average Producing Depth: | 5575 ft. | |
| Oil Wells: | | |
| Currently being produced: | | |
| Flowing: | 21. | |
| Pumping: | 0. | |
| Gas Lift: | 0. | |
| Wells that have produced oil: | | |
| Shut in: | 0. | |
| Plugged and abandoned: | 0. | |
| Converted to gas wells: | 0. | |
| Gas Wells: | | |
| Producing: | 0. | |
| Shut in: | 0. | |
| Dry and abandoned: | 0. | |
| Total wells drilled: | 21. | |
| Production to date: | | |
| Oil Production: | | 160,500. |
| Water Production: | | 15,000. |
| Gas Production: | | |
| Gas produced from oil: | | 53,770. (MSCF) |
| Dry Gas: | | |
| Total gas produced: | | 53,770. |
| Reservoir Data: | | |
| Initial reservoir pressure: | | 2005. PSI |
| Present estimated reservoir pressure: | | 1910. |
| Saturation pressure: | | 3000. |
| Oil A.P.I. gravity: | | 41° |
| Sulphur percentage: | | .05 |
| Royalty Interest: | | |
| Owner: | | 12.5% |
| Other: | | 0.0 |
| Undepreciated tangible assets on lease: | | Not available at this time. |
| Estimated Reserves: | | 1,450,000. |
| Minimum Bid: | | $2,000,000. |

Lease Number 13 Acreage 3000

"Wastelands" Lease

Area Description: The area in which this lease is situated is very hilly and rocky. There is very little rainfall and as a result there is very little water and almost no vegetation. The land is not used for anything.

Geological Data: Other than aerial mappings of the area, no other recent studies have been made of the area. There are stories that this lease was drilled at one time during the 1920's, but the records or the location of the wells cannot be found. The aerial maps appear to indicate that several dome structures may exist under the lease. Studies of this area suggest that the Yates-Seven Rivers formation may occur this far north.

Drilling History: From the information that can be gathered in the area, the original wells were drilled about 1926 to a depth of about 2000 feet by the cable tool method. The wells that were drilled were fairly productive, but due to the high cost of transporting the oil, inefficient production methods and the Great Depression of the thirties, the company apparently went bankrupt and abandoned the field.

Terms: Because it is fairly certain that oil does exist on this lease, the new owner of this lease will not accept less than two dollars per acre for the leasing rights. Drilling must be started within one year or a delay rental payment of one dollar per acre per year will be paid to the lessor by the lessee. The lease will terminate at the end of five years or when it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

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Lease Number 14 Acreage 998

West Windy County Lease

Area Description: This lease is an old run down farm owned by an old man who now resides in Kansas City. Most of the farm is situated on the side of a long sloping hill. About fifty per cent of the area is wooded. A lake on the property provides plenty of water and the roads to the lease are in good condition.

Geological Data: None.

Drilling History: None.

Terms: The owner will consider no bids less than one dollar per acre. Lessee will drill within one year or pay the lessor one dollar per acre per year until drilling does commence or the lease is terminated. The lease will terminate at the end of five years or when it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

Lease Number 15 Acreage 4052

Richard Burtron Estate

Area Description: The terrain in this area is mountainous and very rocky with lush vegetation. The estate is isolated by mountain ranges on all sides, but roads through several passes leading to the lease are fair and passable the year round.

Geological Data: Magnetic surveys, aerial photographs and ground maps have been made of this area recently. There are numerous faults apparent from the visible rock outcroppings with several showing the signs of the black oil sands.

Drilling History: Fifteen years ago a well was drilled on the southern portion of this lease to a depth of 3100 feet. A show of oil was found, but it was not considered economical to produce and the well was abandoned. No other drilling has been done in the area.

Terms: The owner will lease the whole estate to the highest bidder for at least ten thousand dollars or more. Drilling will commence before the end of one year or the lessee will pay a delay rental payment of one dollar per acre per year to the lessor. The lease will be terminated at the end of five years if no drilling has been done or if it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

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Lease Number 16 Acreage 2500

Lake Tract Lease

Area Description: The area of this lease is relatively flat and is about 700 feet above sea level. It is bordered on the west by rolling hills that level off into a plain that is approximately 1500 feet in elevation. The area is part of a state wildlife reserve.

Geological Data: Geological surveys are now in progress and evidence so far indicates that there is a good possibility that several potential oil traps may exist on the lease. This evidence was derived from an analysis that has just been completed on some partially burried outcroppings in the western section of the lease.

Drilling History: No drilling has been done on this lease thus far. The land is owned by the state and is completely undeveloped.

Terms: The state will allow only the minimum amount of disturbance of the natural habitat of the plant and wildlife. The minimum bid the state will consider will be five dollars an acre. Drilling will commence within one year or the lessee will pay the state a delay rental of one dollar per acre per year. The lease will be terminated at the end of five years or when it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

Lease Number 17 Acreage 4100

Past Lease Production Time: 9 months

Producing Formation: Grayburg-Queen
Average Producing Depth: 3650 ft.

Oil Wells:
Currently being produced:
Flowing: 13.
Pumping: 0.
Gas Lift: 0.
Wells that have produced oil:
Shut in: 0.
Plugged and abandoned: 0.
Converted to gas wells: 0.

Gas Wells:
Producing: 0.
Shut in: 0.

Dry and abandoned: 0.
Total wells drilled: 13.

Production to date:
Oil Production: 120,000.
Water Production: 5,000.
Gas Production:
Gas produced from oil: 5,499. (MSCF)
Dry Gas: 0.
Total gas produced: 5,499.

Reservoir Data:
Initial reservoir pressure: 1807.
Present estimated reservoir pressure: 1780.
Saturation pressure: 2000.
Oil A.P.I. gravity: 42°
Sulphur percentage: .5

Royalty Interest:
Owner:
Other: 12.5%

Undepreciated tangible assets on lease: $1,200,000. (estimated)

Estimated Reserves: 1,500,000.

Minimum Bid: $2,000,000.

Lease Number 18 Acreage 2025

Downs Estate Lease

Area Description: Rolling, slightly wooded countryside characterizes the entire 2025 acres offered for lease by the beneficieries of the Downs Estate. The lease's elevation is about 1500 feet above sea level and there are no commercial or residential developments within ten miles.

Geological Data: There is no geological data available.

Drilling History: No wells have been drilled on this land to date. The Petro Wildcat Company has begun drilling on a farm two miles east of the estate on the basis of some favorable seismic readings. These readings indicate that the possibility of a pinchout exists on that lease, and from the lay of the land, the pinchout may extend under part or all of the Downs Estate.

Terms: The owners of the Estate have turned down an offer of two dollars an acre for a leasing bonus and would consider an offer of five dollars or more an acre. Drilling is to commence within one year or the lessee will be liable to the lessor for a delay rental payment of one dollar per year per acre. The lease will terminate at the end of five years is no drilling has been done or in the event that it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

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Lease Number 19 Acreage 1561

Henry A. Jackson Lease

Area Description: This lease is located in the southeastern portion of Kansas where the terrain is rather hilly. There are some wooded spots on the lease and the rest is grass land used for grazing horses.

Geological Data: There is no detailed geological data presently available for this lease. There is little surface evidence that there are subsurface structures under the lease that may contain gas or oil. However, from general geological knowledge of the area, the Bartlesville Sand formation should lie under this lease at an approximate depth of 2000 feet.

Drilling History: There is no record of any drilling that has been done on this lease or on adjacent leases.

Terms: Mr. Jackson will accept no less than two dollars an acre as a bonus for the leasing rights. Drilling must begin within one year or a delay rental of one dollar per acre per year must be paid to the lessor. The lease will be terminated at the end of five years if no drilling has been accomplished or at the time when it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

Lease Number 20 Acreage 3555

| | |
|---|---|
| Past Lease Production Time: | 9 months |
| Producing Formation: | McKee (Simpson) |
| Average Producing Depth: | 9000. ft. |
| Oil Wells: | |
| Currently being produced: | |
| Flowing: | 17. |
| Pumping: | 0. |
| Gas Lift: | 0. |
| Wells that have produced oil: | |
| Shut in: | 0. |
| Plugged and abandoned: | 0. |
| Converted to gas wells: | 0. |
| Gas Wells: | |
| Producing: | 0. |
| Shut in: | 0. |
| Dry and abandoned: | 0. |
| Total wells drilled: | 17. |
| Production to date: | |
| Oil Production: | 210,000. |
| Water Production: | 0. |
| Gas Production: | 66,617. (MSCF) |
| Gas produced from oil: | |
| Dry Gas: | |
| Total gas produced: | 66,617. |
| Reservoir Data: | |
| Initial reservoir pressure: | 3345. |
| Present estimated reservoir pressure: | 2100. |
| Saturation pressure: | 3360. |
| Oil A.P.I. gravity: | 40° |
| Sulphur percentage: | 0. |
| Royalty Interest: | |
| Owner: | 12.5% |
| Other: | 0.0 |
| Undepreciated tangible assets on lease: | $1,080,000. (estimated) |
| Estimated Reserves: | 2,000,000. |
| Minimum Bid: | $1,800,000. |

Lease Number 21 | Acreage 3604

Past Lease Production Time: 1 month

Producing Formation: Silurian
Average Producing Depth: 6000. ft.

Oil Wells:
Currently being produced:
Flowing: 1.
Pumping: 0.
Gas Lift: 0.
Wells that have produced oil:
Shut in: 0.
Plugged and abandoned: 0.
Converted to gas wells: 0.

Gas Wells:
Producing: 0.
Shut in: 0.

Dry and abandoned: 0.
Total wells drilled: 1.

Production to date:
Oil Production: 500.
Water Production: 100.
Gas Production: 4. (MSCF)
Gas produced from oil: 4.
Dry Gas:
Total gas produced: 4.

Reservoir Data:
Initial reservoir pressure: 2930.
Present estimated reservoir pressure: 2930.
Saturation pressure: 3000.
Oil A.P.I. gravity: 43.6
Sulphur percentage: .69

Royalty Interest:
Owner: 12.5%
Other: 0.0

Undepreciated tangible assets on lease: not available.

Estimated Reserves: 1,500,000.

Minimum Bid: $1,000,000.

Lease Number 22 Acreage 750

John Blackman Lease

Area Description: This lease is part of a large farm that borders on the Kansas River, and is a strip of flat land that lies between the river and some sloping hill country. The land is used to grow wheat and sorghum grains.

Geological Data: The owner has had seismic studies made of the lease. The results indicate that a prospective porous formation exists at about 3800 feet to about 4200 feet which is thought to be the Mississippian formation. Another formation beginning at approximately 7500 feet also looks very favorable.

Drilling History: There is no drilling history for this lease. About three miles up the river, development has just been completed this year on the Jack Whitelinger Lease. Ten wells were completed to an average depth of about 4000 feet, and the wells are now flowing roughly 100 barrels per day. There has been no other drilling activity in the area.

Terms: The owner will consider bids of not less than five dollars an acre plus two thousand dollars which is the cost of the seismic study. Lessee must begin to drill within one year or pay lessor a delay rental payment of one dollar per acre per year until drilling commences or the lease is terminated. The lease is terminated at the end of five years or in the event that it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

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Lease Number 23 Acreage 1675

Black Swamp Lease

Area Description: This lease is entirely swamp land located near the Mississippi river in northern Louisiana. There are very few roads to the area and it is inhabited only by wildlife.

Geological Data: There is no geological data available for this lease. Most of the time the swamp is covered with a black oily film from which the swamp gets its name. The oily film could result from oil sweeps or it may be from other sources.

Drilling History: None.

Terms: The owner will lease this land for not less than fifty cents an acre. Drilling must start within one year or a delay rental payment of one dollar per acre per year will be paid to the lessor. The lease will terminate at the end of five years if no drilling has begun or when it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

Lease Number 24 Acreage 1000

Suburban Number 1 Lease

Area Description: The area of the lease is a hilly wooded area on which exists a newly developed residential section. The lease is owned by a number of landowners most of whom live on the land. They have banned together to form a royalty company to handle lease arrangements. The area available for a leasing company's operations is limited due to the close house spacing.

Geological Data: The royalty company has hired a geologist to make a study of the lease to determine the possibility of finding oil. Because of the nature of the area, only a few seismic readings could be taken, but the study concluded that the possibility of the existence of oil in a porous formation at a depth of 3100 feet was excellent. This formation is thought to be part of the Yates formation.

Drilling History: This lease is adjacent to a lease that is now being developed, but drilling data from the lease is being kept confidential. From the little information that can be obtained, producing depths appear to be about 4000 feet, and the wells are flowing well enough to make their allowables.

Terms: The royalty company will not consider bids of less than twenty dollars an acre bonus and will lease to the highest bidder. Severe restrictions will be placed on the driller because of this being a residential area. Drilling is to commence within one year or a delay rental will be paid to the lessor by the lessee of one dollar per acre per year. The lease will be terminated at the end of five years or when it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

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Lease Number 25 Acreage 910

Bill Smith Lease

Area Description: This lease is located in the Ohio River valley in Ray County, Kentucky. The land is quite hilly although the hills are not very high. The lease is situated about four miles south of the river.

Geological Data: None.

Drilling History: None.

Terms: Mr. Smith has agreed to lease to the highest bidder if the bid is one thousand dollars or more. The lessee must start drilling within one year or he must pay a delay rental of one dollar per acre per year. The lease will terminate at the end of five years if no drilling has been done or when it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

Lease Number 26 Acreage 2100

Cartley's Land Tract Lease

Area Description: This tract of land is in the heart of the Kentucky Blue Grass country and is presently used to pasture race horses. The land was leased 19 months ago and the lessee had geological studies made but the lease was never proven. The lessee is now attempting to sell the lease for he is retiring from the oil business.

Geological Data: From the studies made recently on this lease, it was determined that at least one definite unconformity existed under the western section of the lease which ended at a large fault. The depth of the cap rock appeared to be about 1500 feet below the surface. Several layers of porous rock were detected under the cap rock that have definite possibilities of being productive.

Drilling History: No drilling has been done on this lease or adjacent leases.

Terms: The present lessee is asking for a minimum bid of two dollars and fifty cents an acre plus the cost of the geological studies which was two thousand dollars. Drilling must commence within one year or lessee will pay the land owner one dollar per acre per year as a delay rental charge. The present lessee will reimburse the land owner for the year's delay rental that the new lessee has to drill. The lease will be terminated at the end of five years or in the event that it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

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Lease Number 27 Acreage 7000

Red Desert Lease

Area Description: This piece of land is sandy and dry and flat as far as the eye can see. It is uninhabited except for a few clusters of houses on the northwestern edge. Because of the climate and the land conditions, the area has not been developed and is considered a wasteland.

Geological Data: None.

Drilling History: This land has not been drilled on as this is the first time it has been available for leasing. A dry hole was drilled about two years ago some ten miles south of this lease which is the only record of drilling in this area.

Terms: The owners will lease this land to the highest bidder for a minimum of three thousand dollars bonus. Drilling must start within a year or the lessee will pay the lessor a delay rental payment of one dollar per acre per year until drilling does start. The lease will terminate at the end of five years or when it is mutually agreed that the production of oil and/or gas is not, or is no longer economical.

Lease Number 28 Acreage 2111

Past Lease Production Time: 1 Month

Producing Formation: Bowers Sand
Average Producing Depth: 2100. ft.

Oil Wells:
- Currently being produced:
  - Flowing: 1.
  - Pumping: 0.
  - Gas Lift: 0.
- Wells that have produced oil:
  - Shut in: 0.
  - Plugged and abandoned: 0.
  - Converted to gas wells: 0.

Gas Wells:
- Producing: 0.
- Shut in: 0.

Dry and abandoned: 0.
Total wells drilled: 1.

Production to date:
- Oil Production: 1000.
- Water Production: 0.
- Gas Production:
  - Gas produced from oil: 200.
  - Dry Gas: 0.
  - Total gas produced: 200.

Reservoir Data:
- Initial reservoir pressure: 1918.
- Present estimated reservoir pressure: 1918.
- Saturation pressure: 2500.

Oil A.P.I. gravity: 32°
Sulphur percentage: 1.

Royalty Interest:
- Owner: 12.5%
- Other: 0.0

Undepreciated tangible assets on lease: $54,000. (estimated)

Estimated Reserves: 600,000.

Minimum Bid: $900,000.

Lease Number 29 Acreage 2777

| | |
|---|---|
| Past Lease Production Time: | 3 Months |
| Producing Formation: | Grayburg |
| Average Producing Depth: | 4100 ft. |

| | | |
|---|---|---|
| Oil Wells: | | |
| Currently being produced: | | |
| Flowing: | 2. | |
| Pumping: | 0. | |
| Gas Lift: | 0. | |
| Wells that have produced oil: | | |
| Shut in: | 0. | |
| Plugged and abandoned: | 0. | |
| Converted to gas wells: | 0. | |
| Gas Wells: | | |
| Producing: | 0. | |
| Shut in: | 0. | |
| Dry and abandoned: | 0. | |
| Total wells drilled: | 2. | |
| Production to date: | | |
| Oil Production: | 6000. | |
| Water Production: | 110. | |
| Gas Production: | | |
| Gas produced from oil: | 750. | (MSCF) |
| Dry Gas: | 0. | |
| Total gas produced: | 750. | |
| Reservoir Data: | | |
| Initial reservoir pressure: | | 2018. |
| Present estimated reservoir pressure: | | 1920. |
| Saturation pressure: | | 2100. |
| Oil A.P.I. gravity: | | 37° |
| Sulphur percentage: | | 1.0 |
| Royalty Interest: | | |
| Owner: | | 12.5% |
| Other: | | 0.0 |
| Undepreciated tangible assets on lease: | | $100,000. |
| Estimated Reserves: | | 800,000. |
| Minimum Bid: | | $750,000. |

Lease Number 30 Acreage 1000

Past Lease Production Time: 2 months

Producing Formation: Queen
Average Producing Depth: 3800 ft.

| | |
|---|---|
| Oil Wells: | |
| Currently being produced: | |
| Flowing: | 9. |
| Pumping: | 0. |
| Gas Lift: | 0. |
| Wells that have produced oil: | |
| Shut in: | 0. |
| Plugged and abandoned: | 0. |
| Converted to gas wells: | 0. |
| Gas Wells: | |
| Producing: | 0. |
| Shut in: | 0. |
| Dry and abandoned: | 0. |
| Total wells drilled: | 9. |
| Production to date: | |
| Oil Production: | 7500. |
| Water Production: | 0. |
| Gas Production: | |
| Gas produced from oil: | 5168. (MSCF) |
| Dry Gas: | |
| Total gas produced: | 5168. |
| Reservoir Data: | |
| Initial reservoir pressure: | 3580. |
| Present estimated reservoir pressure: | 3500. |
| Saturation pressure: | 3500. |
| Oil A.P.I. gravity: | 40° |
| Sulphur percentage: | .4 |
| Royalty Interest: | |
| Owner: | 12.5% |
| Other: | 0.0 |
| Undepreciated tangible assets on lease: | \$360,000. |
| Estimated Reserves: | 300,000. |
| Minimum Bid: | \$600,000. |

Lease Number 31 Acreage 1988

| | |
|---|---|
| Past Lease Production Time: | 2 Months |
| Producing Formation: | Seven Rivers |
| Average Producing Depth: | 3850 ft. |

| | | | |
|---|---|---|---|
| Oil Wells: | | | |
| Currently being produced: | | | |
| Flowing: | 1. | | |
| Pumping: | 0. | | |
| Gas Lift: | 0. | | |
| Wells that have produced oil: | | | |
| Shut in: | 0. | | |
| Plugged and abandoned: | 0. | | |
| Converted to gas wells: | 0. | | |
| Gas Wells: | | | |
| Producing: | 0. | | |
| Shut in: | 0. | | |
| Dry and abandoned: | 0. | | |
| Total wells drilled: | 1. | | |
| Production to date: | | | |
| Oil Production: | | 1500. | |
| Water Production: | | 0. | |
| Gas Production: | | | |
| Gas produced from oil: | | 300. | (MSCF) |
| Dry Gas: | | 0. | |
| Total gas produced: | | 300. | |
| Reservoir Data: | | | |
| Initial reservoir pressure: | | 2100. | |
| Present estimated reservoir pressure: | | 2060. | |
| Saturation pressure: | | 2300. | |
| Oil A.P.I. gravity: | | 35° | |
| Sulphur percentage: | | 0. | |
| Royalty Interest: | | | |
| Owner: | | 12.5% | |
| Other: | | 0.0 | |
| Undepreciated tangible assets on lease: | | | |
| Estimated Reserves: | | 1,500,000. | |
| Minimum Bid: | | $900,000. | |

Lease Number 32 Acreage 3100

Santon's Farm Lease

Area Description: This farmland was leased approximately seven years ago to the Accidental Drilling Company. Accidental had a five year lease and decided to abandon the property about the time it would have expired. Their equipment was in poor repair and they did not feel it was economical to renew or repair it. This land has been used as grazing land for the last two years.

Geological Data: Drilling was originally started based on seismic readings that detected several faults. The leasing company drilled 2552 feet to these faults. The wells initially flowed about 200 barrels per day with about fifteen per cent water. Since the lease was abandoned, new seismic readings taken on deeper formations indicate a possible dome structure at a depth of about 6100 feet.

Drilling History: There were nine wells on the lease. All of them were abandoned and filled in. The wells were producing about five barrels a day by pumping with no increase in the percentage of water. None of the wells exceeded 3500 feet deep. There was no secondary recovery attempted on this reservoir. The wells were not acid treated or fractured.

Terms: Mr. Santon will consider offers of five thousand dollars or more as a bonus to lease. Drilling will commence within one year or a delay rental payment of one dollar per acre per year will be paid to the lessor. The lease will terminate at the end of five years or in the event that it is mutually agreed that the production of oil and/or gas is not, or no longer economical.

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Lease Number 33 Acreage 1010

Lake Watusi Lease

Area Description: The lease is located on the shores of beautiful Lake Watusi. The terrain is slightly hilly and about twenty-five per cent wooded. This lease is part of a large dairy farm and most of the land in the lease is used as pasture.

Geological Data: There are no prospective formations evident from the appearence on the surface and no other geological data is available.

Drilling History: None for this area.

Terms: This lease is available for a minimum bonus of two thousand dollars and all bids will be considered. Drilling is to be started within one year or the leasing company will pay the owner a delay rental of one dollar per acre per year until drilling is started. The lease will terminate at the end of five years or when it is mutually agreed that it it not, or is no longer economical to produce oil and/or gas.

Lease Number 34 Acreage 5231

| | |
|---|---|
| Past Lease Production Time: | 3 months |
| Producing Formation: | Queen |
| Average Producing Depth: | 3000 ft. |
| **Oil Wells:** | |
| Currently being produced: | |
| Flowing: | 7. |
| Pumping: | 0. |
| Gas Lift: | 0. |
| Wells that have produced oil: | |
| Shut in: | |
| Plugged and abandoned: | 0. |
| Converted to gas wells: | 0. |
| **Gas Wells:** | |
| Producing: | 0. |
| Shut in: | 0. |
| Dry and abandoned: | 0. |
| Total wells drilled: | 7. |
| **Production to date:** | |
| Oil Production: | 10,500. |
| Water Production: | 110. |
| Gas Production: | |
| Gas produced from oil: | 8469. (MSCF) |
| Dry Gas: | |
| Total gas produced: | 8469. |
| **Reservoir Data:** | |
| Initial reservoir pressure: | 3410. PSI |
| Present estimated reservoir pressure: | 3341. |
| Saturation pressure: | 3520. |
| Oil A.P.I. gravity: | 38° |
| Sulphur percentage: | 1.07 |
| **Royalty Interest:** | |
| Owner: | 12.5% |
| Other: | 0.0 |
| Undepreciated tangible assets on lease: | $100,000. |
| Estimated Reserves: | 400,000. |
| Minimum Bid: | $1,000,000. |

Lease Number 35 | Acreage 1950

| | | |
|---|---|---|
| Past Lease Production Time: | 10. Months | |
| Producing Formation: | Ellenburger (lime) | |
| Average Producing Depth: | 7900. ft. | |
| Oil Wells: | | |
| Currently being produced: | | |
| Flowing: | 17. | |
| Pumping: | 0. | |
| Gas Lift: | 0. | |
| Wells that have produced oil: | | |
| Shut in: | | |
| Plugged and abandoned: | 0. | |
| Converted to gas wells: | 0. | |
| Gas Wells: | | |
| Producing: | 0. | |
| Shut in: | 0. | |
| Dry and abandoned: | 0. | |
| Total wells drilled: | 17. | |
| Production to date: | | |
| Oil Production: | | 136,500. |
| Water Production: | | 0. |
| Gas Production: | | |
| Gas produced from oil: | | 120,713. (MSCF) |
| Dry Gas: | | |
| Total gas produced: | | 120,713. |
| Reservoir Data: | | |
| Initial reservoir pressure: | | 3500. |
| Present estimated reservoir pressure: | | 3355. |
| Saturation pressure: | | 3410. |
| Oil A.P.I. gravity: | | 42° |
| Sulphur percentage: | | 0. |
| Royalty Interest: | | |
| Owner: | | 12.5% |
| Other: | | 0.0 |
| Undepreciated tangible assets on lease: | | $360,000. |
| Estimated Reserves: | | 590,000. |
| Minimum Bid: | | $954,000. |

Lease Number 36 — Acreage 5501

Past Lease Production Time: 3 Months

Producing Formation: Seven Rivers
Average Producing Depth: 3200 ft.

Oil Wells:
- Currently being produced:
  - Flowing: 9.
  - Pumping: 0.
  - Gas Lift: 0.
- Wells that have produced oil:
  - Shut in: 0.
  - Plugged and abandoned: 0.
  - Converted to gas wells: 0.

Gas Wells:
- Producing: 0.
- Shut in: 0.

Dry and abandoned: 0.
Total wells drilled: 9.

Production to date:
- Oil Production: 7500.
- Water Production: 75.
- Gas Production:
  - Gas produced from oil: 2381. (MSCF)
  - Dry Gas:
  - Total gas produced: 2381.

Reservoir Data:
- Initial reservoir pressure: 2011.
- Present estimated reservoir pressure: 2000.
- Saturation pressure: 2000.

Oil A.P.I. gravity: 42°
Sulphur percentage: 0.

Royalty Interest:
- Owner: 12.5%
- Other: 0.0

Undepreciated tangible assets on lease: not available

Estimated Reserves: 1,000,000.
Minimum Bid: $2,000,000.

Lease Number 37 Acreage 1237

Past Lease Production Time: 3 Months

Producing Formation: Seven Rivers
Average Producing Depth: 3050 ft.

| | |
|---|---|
| Oil Wells: | |
| Currently being produced: | |
| Flowing: | 5. |
| Pumping: | 0. |
| Gas Lift: | 0. |
| Wells that have produced oil: | |
| Shut in: | 0. |
| Plugged and abandoned: | 0. |
| Converted to gas wells: | 0. |
| Gas Wells: | |
| Producing: | 0. |
| Shut in: | 0. |
| Dry and abandoned: | 2. |
| Total wells drilled: | 7. |

| | |
|---|---|
| Production to date: | |
| Oil Production: | 7500. |
| Water Production: | 600. |
| Gas Production: | |
| Gas produced from oil: | 5577. |
| Dry Gas: | |
| Total gas produced: | 5577. |
| Reservoir Data: | |
| Initial reservoir pressure: | 1327. |
| Present estimated reservoir pressure: | 1210. |
| Saturation pressure: | 1400. |
| Oil A.P.I. gravity: | 35° |
| Sulphur percentage: | .09 |
| Royalty Interest: | |
| Owner: | 12.5% |
| Other: | 0.0 |
| Undepreciated tangible assets on lease: | not available |
| Estimated Reserves: | 200,000. |
| Minimum Bid: | $400,000. |

Lease Number 38 | Acreage 790

Past Lease Production Time: 9 Months

Producing Formation: Bartlesville Sands
Average Producing Depth: 2500 ft.

Oil Wells:
- Currently being produced:
  - Flowing: 6.
  - Pumping: 0.
  - Gas Lift: 0.
- Wells that have produced oil:
  - Shut in: 0.
  - Plugged and abandoned: 0.
  - Converted to gas wells: 0.

Gas Wells:
- Producing: 0.
- Shut in: 0.

Dry and abandoned: 1.
Total wells drilled: 7.

Production to date:
- Oil Production: 55,000.
- Water Production: 5,500.
- Gas Production:
  - Gas produced from oil: 46,000. (MSCF)
  - Dry Gas:
  - Total gas produced: 46,000. (MSCF)

Reservoir Data:
- Initial reservoir pressure: 1405. PSI
- Present estimated reservoir pressure: 1115.
- Saturation pressure: 2000.

Oil A.P.I. gravity: 33°
Sulphur percentage: 0.

Royalty Interest:
- Owner: 12.5%
- Other: 0.0

Undepreciated tangible assets on lease: not available.

Estimated Reserves: 210,000.

Minimum Bid: $300,000.

Lease Number 39 Acreage 3500

| | |
|---|---|
| Past Lease Production Time: | 4 years |
| Producing Formation: | Queen(sand) |
| Average Producing Depth: | 2755 ft. |
| Oil Wells: | |
| Currently being produced: | |
| Flowing: | 0. |
| Pumping: | 5. |
| Gas Lift: | 0. |
| Wells that have produced oil: | |
| Shut in: | 0. |
| Plugged and abandoned: | 0. |
| Converted to gas wells: | 0. |
| Gas Wells: | |
| Producing: | 0. |
| Shut in: | 0. |
| Dry and abandoned: | 3. |
| Total wells drilled: | 8. |
| Production to date: | |
| Oil Production: | 91,000. |
| Water Production: | 10,000. |
| Gas Production: | |
| Gas produced from oil: | 263,400. (MSCF) |
| Dry Gas: | |
| Total gas produced: | 263,400. |
| Reservoir Data: | |
| Initial reservoir pressure: | 3500. |
| Present estimated reservoir pressure: | 500. |
| Saturation pressure: | 3000. |
| Oil A.P.I. gravity: | 43° |
| Sulphur percentage: | .1 |
| Royalty Interest: | |
| Owner: | 12.5% |
| Other: | 0.0 |
| Undepreciated tangible assets on lease: | none |
| Estimated Reserves: | 50,000. |
| Minimum Bid: | $100,000. |

Lease Number 40 Acreage 2315

| | |
|---|---|
| Past Lease Production Time: | 6 Months |
| Producing Formation: | Grayburg (Permain) |
| Average Producing Depth: | 2600 ft. |
| **Oil Wells:** | |
| Currently being produced: | |
| Flowing: | 7. |
| Pumping: | 0. |
| Gas Lift: | 0. |
| Wells that have produced oil: | |
| Shut in: | 1. |
| Plugged and abandoned: | 0. |
| Converted to gas wells: | 0. |
| **Gas Wells:** | |
| Producing: | 0. |
| Shut in: | 0. |
| Dry and abandoned: | 0. |
| Total wells drilled: | 8. |
| **Production to date:** | |
| Oil Production: | 10,500. |
| Water Production: | 0. |
| Gas Production: | |
| Gas produced from oil: | 8,547. (MSCF) |
| Dry Gas: | 0. |
| Total gas produced: | 8,547. |
| **Reservoir Data:** | |
| Initial reservoir pressure: | 1500. |
| Present estimated reservoir pressure: | 1409. |
| Saturation pressure: | 1590. |
| Oil A.P.I. gravity: | 36° |
| Sulphur percentage: | 0.9 |
| **Royalty Interest:** | |
| Owner: | 12.5% |
| Other: | 0.0 |
| Undepreciated tangible assets on lease: | $80,000. |
| Estimated Reserves: | 850,000. |
| Minimum Bid: | $1,320,000. |

Lease Number 41 Acreage 2666

| | | |
|---|---|---|
| Past Lease Production Time: | 12 Months | |
| Producing Formation: | San Andres | |
| Average Producing Depth: | 2750 ft. | |
| **Oil Wells:** | | |
| Currently being produced: | | |
| Flowing: | 14. | |
| Pumping: | 0. | |
| Gas Lift: | 0. | |
| Wells that have produced oil: | | |
| Shut in: | 0. | |
| Plugged and abandoned: | 1. | |
| Converted to gas wells: | 0. | |
| **Gas Wells:** | | |
| Producing: | 0. | |
| Shut in: | 0. | |
| Dry and abandoned: | 0. | |
| Total wells drilled: | 15. | |
| **Production to date:** | | |
| Oil Production: | | 130,000. |
| Water Production: | | none |
| Gas Production: | | |
| Gas produced from oil: | | 98,000. (MSCF) |
| Dry Gas: | | 0. |
| Total gas produced: | | 98,000. |
| **Reservoir Data:** | | |
| Initial reservoir pressure: | | 1350. |
| Present estimated reservoir pressure: | | 1050. |
| Saturation pressure: | | 1300. |
| Oil A.P.I. gravity: | | 23° |
| Sulphur percentage: | | .9 |
| **Royalty Interest:** | | |
| Owner: | | 12.5% |
| Other: | | 0.0 |
| Undepreciated tangible assets on lease: | | $300,000. |
| Estimated Reserves: | | 900,000. |
| Minimum Bid: | | $1,100,000. |

Lease Number 42 Acreage 1290

| | | |
|---|---|---|
| Past Lease Production Time: | 7 years | |
| Producing Formation: | Yates | |
| Average Producing Depth: | 1350 ft. | |
| **Oil Wells:** | | |
| Currently being produced: | | |
| Flowing: | 0. | |
| Pumping: | 13. | |
| Gas Lift: | 0. | |
| Wells that have produced oil: | | |
| Shut in: | 0. | |
| Plugged and abandoned: | 0. | |
| Converted to gas wells: | 0. | |
| **Gas Wells:** | | |
| Producing: | 0. | |
| Shut in: | 0. | |
| Dry and abandoned: | 4. | |
| Total wells drilled: | 17. | |
| **Production to date:** | | |
| Oil Production: | 743,210. | |
| Water Production: | 1,657,000. | (produced less injected) |
| Gas Production: | | |
| Gas produced from oil: | 2,118,000. | (MSCF) |
| Dry Gas: | 0. | |
| Total gas produced: | 2,118,000. | |
| **Reservoir Data:** | | |
| Initial reservoir pressure: | 1750. | |
| Present estimated reservoir pressure: | 350. | |
| Saturation pressure: | 1600. | |
| Oil A.P.I. gravity: | 23° | |
| Sulphur percentage: | 0 | |
| **Royalty Interest:** | | |
| Owner: | 12.5% | |
| Other: | 0.0 | |
| Undepreciated tangible assets on lease: | $200,000. | |
| Estimated Reserves: | 450,000. | |
| Minimum Bid: | $500,000. | |

Lease Number 43 Acreage 1511

| | | |
|---|---|---|
| Past Lease Production Time: | 2 Months | |
| Producing Formation: | Simpson | |
| Average Producing Depth: | 4100. ft. | |
| **Oil Wells:** | | |
| Currently being produced: | | |
| Flowing: | 1. | |
| Pumping: | 0. | |
| Gas Lift: | 0. | |
| Wells that have produced oil: | | |
| Shut in: | 0. | |
| Plugged and abandoned: | 0. | |
| Converted to gas wells: | 0. | |
| **Gas Wells:** | | |
| Producing: | 0. | |
| Shut in: | 0. | |
| Dry and abandoned: | 0. | |
| Total wells drilled: | 1. | |
| **Production to date:** | | |
| Oil Production: | 1500. | |
| Water Production: | 378. | |
| Gas Production: | | |
| Gas produced from oil: | 600. | (MSCF) |
| Dry Gas: | 0. | |
| Total gas produced: | 600. | |
| **Reservoir Data:** | | |
| Initial reservoir pressure: | 3493. | PSI |
| Present estimated reservoir pressure: | 3490. | |
| Saturation pressure: | 3400. | |
| Oil A.P.I. gravity: | 34° | |
| Sulphur percentage: | 0. | |
| **Royalty Interest:** | | |
| Owner: | 12.5% | |
| Other: | 0.0 | |
| Undepreciated tangible assets on lease: | $50,000. | |
| Estimated Reserves: | 750,000. | |
| Minimum Bid: | $500,000. | |

Lease Number 44 Acreage 2850

Bar-B-Q Ranch Lease

Area Description: This area is rolling grasslands in southern Wyoming, spotted with rock crests that break abruptly into more grasslands. It is presently used to pasture sheep.

Geological Data: The adjoining ranch was leased about three years ago and has been developed and turned out to be very productive. Seismic work has been done on the area of this lease next to the producing lease and indications are that a fairly large anticline exists under this lease. The top of the porous layer that may be productive lies about 1700 feet beneath the surface.

Drilling History: No wells have been drilled on this lease. The fifteen wells on the adjoining lease are presently averaging about 82 barrels a day flowing from a depth of 2200 feet.

Terms: The owner will accept bids for consideration of five dollars per acre plus reimbursement of the fee he paid for the geological studies which was two thousand five hundred dollars. Drilling must begin within one year or the lessee will pay the lessor a delay rental payment of one dollar per acre per year until drilling has started. The lease will terminate at the end of five years or when it determined that it is not or is no longer economical to produce oil and/or gas.

---

Lease Number 45 Acreage 996

Carolina Coastland Lease

Area Description: This lease is located in Eastern North Carolina where the terrain is flat and sandy. This is an area in which new interest in exploration has recently sprung up, and many oil people are very enthusiastic about its future in oil production.

Geological Data: Magnetic surveys have been recently made of this area and they indicated that the sedimentary basin was favorable. No prospective formations could be detected.

Drilling History: This is a new area of drilling interest but none has been done so far.

Terms: The owner will consider bids of one thousand dollars or more as a bonus for leasing this land. Drilling must commence within one year or a delay rental must be paid to the lessor of one dollar per acre per year. The lease will be terminated within five years or when it is determined that production of oil and/or gas is not, or is no longer economical.

Lease Number 46 Acreage 1999

| | |
|---|---|
| Past Lease Production Time: | 2 Months |
| Producing Formation: | Silurian |
| Average Producing Depth: | 7200 ft. |
| **Oil Wells:** | |
| Currently being produced: | |
| Flowing: | 1. |
| Pumping: | 0. |
| Gas Lift: | 0. |
| Wells that have produced oil: | |
| Shut in: | 0. |
| Plugged and abandoned: | 0. |
| Converted to gas wells: | 0. |
| **Gas Wells:** | |
| Producing: | 0. |
| Shut in: | 0. |
| Dry and abandoned: | 0. |
| Total wells drilled: | 1. |
| **Production to date:** | |
| Oil Production: | 1500. |
| Water Production: | 300. |
| Gas Production: | |
| Gas produced from oil: | 350. (MSCF) |
| Dry Gas: | 0. |
| Total gas produced: | 350. |
| **Reservoir Data:** | |
| Initial reservoir pressure: | 3223. |
| Present estimated reservoir pressure: | 3200. |
| Saturation pressure: | 3300. |
| Oil A.P.I. gravity: | 43.6° |
| Sulphur percentage: | .69 |
| **Royalty Interest:** | |
| Owner: | 12.5% |
| Other: | 0.0 |
| Undepreciated tangible assets on lease: | Not available. |
| Estimated Reserves: | 1,000,000. |
| Minimum Bid: | $633,000. |

Lease Number 47 | Acreage 2801

| | |
|---|---|
| Past Lease Production Time: | 3 Months |
| Producing Formation: | Ellenburger |
| Average Producing Depth: | 8000. ft. |
| **Oil Wells:** | |
| Currently being produced: | |
| Flowing: | 9. |
| Pumping: | 0. |
| Gas Lift: | 0. |
| Wells that have produced oil: | |
| Shut in: | 0. |
| Plugged and abandoned: | 0. |
| Converted to gas wells: | 0. |
| **Gas Wells:** | |
| Producing: | 0. |
| Shut in: | 0. |
| Dry and abandoned: | 0. |
| Total wells drilled: | 9. |
| **Production to date:** | |
| Oil Production: | 12,000. |
| Water Production: | 60. |
| Gas Production: | |
| Gas produced from oil: | 6100. (MSCF) |
| Dry Gas: | 0. |
| Total gas produced: | 6100. |
| **Reservoir Data:** | |
| Initial reservoir pressure: | 3433. |
| Present estimated reservoir pressure: | 3380. |
| Saturation pressure: | 3300. |
| Oil A.P.I. gravity: | 39° |
| Sulphur percentage: | .1 |
| **Royalty Interest:** | |
| Owner: | 12.5% |
| Other: | 0.0 |
| Undepreciated tangible assets on lease: | Not available. |
| Estimated Reserves: | 300,000. |
| Minimum Bid: | $200,000. |

Lease Number 48 Acreage 2776

| | |
|---|---|
| Past Lease Production Time: | 1 Year |
| Producing Formation: | Ellenburger |
| Average Producing Depth: | 9000 ft. |
| Oil Wells: | |
| Currently being produced: | |
| Flowing: | 16. |
| Pumping: | 0. |
| Gas Lift: | 0. |
| Wells that have produced oil: | |
| Shut in: | 0. |
| Plugged and abandoned: | 0. |
| Converted to gas wells: | 0. |
| Gas Wells: | |
| Producing: | 0. |
| Shut in: | 0. |
| Dry and abandoned: | 0. |
| Total wells drilled: | 16. |
| Production to date: | |
| Oil Production: | 150,000. |
| Water Production: | 300. |
| Gas Production: | |
| Gas produced from oil: | 101,000. (MSCF) |
| Dry Gas: | 0. |
| Total gas produced: | 101,000. |
| Reservoir Data: | |
| Initial reservoir pressure: | 4247. |
| Present estimated reservoir pressure: | 3900. |
| Saturation pressure: | 4200. |
| Oil A.P.I. gravity: | 41.1° |
| Sulphur percentage: | .0 |
| Royalty Interest: | |
| Owner: | 12.5% |
| Other: | 0.0 |
| Undepreciated tangible assets on lease: | not available. |
| Estimated Reserves: | 1,000,000. |
| Minimum Bid: | $1,000,000. |

Lease Number 49 Acreage 2208

Louisiana Marshlands Lease

Area Description: This land is entirely marshland and all of it is at least partially submerged. An oil slick or film is frequently found in some sections of the lease on the surface of the water. Recently the scum was analyzed and determined to be crude oil. It is assumed that the oil exudes from the ground as the marsh is not navigable and is not directly connected to the Gulf where ships might well be accountable for the oil. Also there are no producing oil fields in the area.

Geological Data: None.

Drilling History: This lease was drilled in the early 1930's, however, the adverse working conditions and the depression forced the company to abandon the lease. A short time later the company went out of business and the records of the drilling cannot be located.

Terms: The state owns the land and is prepared to accept a minimum bid of seven thousand dollars, but it will lease to the highest bidder. Drilling must start within one year or the lessee will pay the state a delay rental of one dollar per acre per year until the time when drilling is started. The lease will be terminated at the end of five years or when it is mutually agreed that the production of oil and/or gas is not, or is no longer economical.

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Lease Number 50 Acreage 10,000

Chief Rainbow Lease

Area Description: The land in this lease is open range grassland used for grazing the cattle of the Indians. Rocks protrude in an irregular fashion and there are a few trees in some of the valleys. This land is part of the Pomocoky Indian Reservation.

Geological Data: There are thought to be two favorable sedimentary layers in the area of this lease, but this has not been tested.

Drilling History: There has been no drilling on this lease or in the vicinity of it.

Terms: The Council of Chiefs of the Pomocokys will accept a minimum bonus of twelve thousand dollars to lease but will lease to the highest bidder. Drilling must begin within one year or the lessee will pay a delay rental of one dollar per acre per year. The lease will terminate at the end of five years or when it is mutually determined that production of oil and/or gas is not, or is no longer economical.

Lease Number 51 | Acreage 5700

Past Lease Production Time: 6 Months

| | |
|---|---|
| Producing Formation: | Bartlesville Sand |
| Average Producing Depth: | 2200 ft. |

| | | |
|---|---|---|
| Oil Wells: | | |
| Currently being produced: | | |
| Flowing: | 3. | |
| Pumping: | 0. | |
| Gas Lift: | 0. | |
| Wells that have produced oil: | | |
| Shut in: | 0. | |
| Plugged and abandoned: | 0. | |
| Converted to gas wells: | 0. | |
| Gas Wells: | | |
| Producing: | 0. | |
| Shut in: | 0. | |
| Dry and abandoned: | 0. | |
| Total wells drilled: | 3. | |
| Production to date: | | |
| Oil Production: | 27,000. | |
| Water Production: | 450. | |
| Gas Production: | 5,400. | (MSCF) |
| Gas produced from oil: | 5,400. | |
| Dry Gas: | 0. | |
| Total gas produced: | 5,400. | |

| | |
|---|---|
| Reservoir Data: | |
| Initial reservoir pressure: | 2500. |
| Present estimated reservoir pressure: | 2485. |
| Saturation pressure: | 2400. |
| Oil A.P.I. gravity: | 35° |
| Sulphur percentage: | 0. |
| Royalty Interest: | |
| Owner: | 12.5% |
| Other: | 0.0 |
| Undepreciated tangible assets on lease: | |
| Estimated Reserves: | 4,000,000. |
| Minimum Bid: | $2,500,000. |

Lease Number 52 Acreage 670

| | | |
|---|---|---|
| Past Lease Production Time: | 5 Years | |
| Producing Formation: | Yates | |
| Average Producing Depth: | 4100. ft. | |
| **Oil Wells:** | | |
| Currently being produced: | | |
| Flowing: | 2. | |
| Pumping: | 0. | |
| Gas Lift: | 0. | |
| Wells that have produced oil: | | |
| Shut in: | 0. | |
| Plugged and abandoned: | 0. | |
| Converted to gas wells: | 0. | |
| **Gas Wells:** | | |
| Producing: | 0. | |
| Shut in: | 0. | |
| Dry and abandoned: | 2. | |
| Total wells drilled: | 4. | |
| **Production to date:** | | |
| Oil Production: | | 10,360. |
| Water Production: | | 345. |
| Gas Production: | | |
| Gas produced from oil: | | 3000. (MSCF) |
| Dry Gas: | | 0. |
| Total gas produced: | | 3000. |
| **Reservoir Data:** | | |
| Initial reservoir pressure: | | 1611. PSI |
| Present estimated reservoir pressure: | | 1000. |
| Saturation pressure: | | 2100. |
| Oil A.P.I. gravity: | | 34° |
| Sulphur percentage: | | 1.0 |
| **Royalty Interest:** | | |
| Owner: | | 12.5% |
| Other: | | 0.0 |
| Undepreciated tangible assets on lease: | | none |
| Estimated Reserves: | | 65,000. |
| Minimum Bid: | | $80,000. |

Lease Number 53 Acreage 1231

| | | |
|---|---|---|
| Past Lease Production Time: | 40 Months | |
| Producing Formation: | Yates | |
| Average Producing Depth: | 3000. ft. | |
| Oil Wells: | | |
| Currently being produced: | | |
| Flowing: | 0. | |
| Pumping: | 5. | |
| Gas Lift: | 0. | |
| Wells that have produced oil: | | |
| Shut in: | 0. | |
| Plugged and abandoned: | 0. | |
| Converted to gas wells: | 0. | |
| Gas Wells: | | |
| Producing: | 0. | |
| Shut in: | 0. | |
| Dry and abandoned: | 3. | |
| Total wells drilled: | 8. | |
| Production to date: | | |
| Oil Production: | | 295,000. |
| Water Production: | | 280,000. |
| Gas Production: | | |
| Gas produced from oil: | | 310,000. (MSCF) |
| Dry Gas: | | 0. |
| Total gas produced: | | 310,000. |
| Reservoir Data: | | |
| Initial reservoir pressure: | | 1611. |
| Present estimated reservoir pressure: | | |
| Saturation pressure: | | 1800. |
| Oil A.P.I. gravity: | | 30° |
| Sulphur percentage: | | 0.9 |
| Royalty Interest: | | |
| Owner: | | 12.5% |
| Other: | | 0.0 |
| Undepreciated tangible assets on lease: | | |
| Estimated Reserves: | | 300,000. |
| Minimum Bid: | | $400,000. |

Lease Number 54 Acreage 1330

Jones Lease

Area Description: The terrain of the area is hilly and rocky. The southern border of the lease is formed by the Missouri River. A small part of the lease is used to grow crops, but it is mainly used for cattle grazing.

Geological Data: The only geological data available are aerial photographs taken by the State Geological Survey in 1960. A brief examination denotes an anticline structure may exist in the area of the lease. It appears to be under about two-thirds of the lease running east and west parallel to the river. More detailed studies are indicated.

Drilling History: A well was drilled to about 3850 feet on an adjoining lease that produced a show of oil but mostly brine. The company drilling the well was a small wildcatter who used very little geological data to support his choice of the drilling sight. This well was drilled before the aerial photographs were made and it is believed that the well was drilled at the very edge of the structure. Well or core data is not available.

Terms: The owner will consider no less than fifty cents an acre as a bonus for the lease. Drilling is to commence within one year or a delay rental will be paid by the lessee to the lessor of one dollar per acre per year. The lease will be terminated at the end of five years or when it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

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Lease Number 55 Acreage 880

Joe Funk Lease

Area Description: Level to slightly rolling land describes this lease located in west central Nebraska. It borders on a state owned lake.

Geological Data: Although there is no geological data available at this time, this area is fast becoming a good producer of oil and gas. Most of the production in the area is from formations from six to eight thousand feet deep.

Drilling History: There is no record of drilling for oil on this lease.

Terms: Mr. Funk will lease the land to the highest bidder for not less than eight hundred dollars. Drilling should start within one year or lessee will be liable to lessor for a delay rental payment of one dollar per acre per year. The lease will be terminated at the end of five years if no drilling has been started or at such time that it is mutually agreed that production of oil and/or gas is not, or is no longer economical.

Lease Number 56 Acreage 6000.

Past Lease Production Time: 6 Months

Producing Formation: Grayburg
Average Producing Depth: 4110 ft.

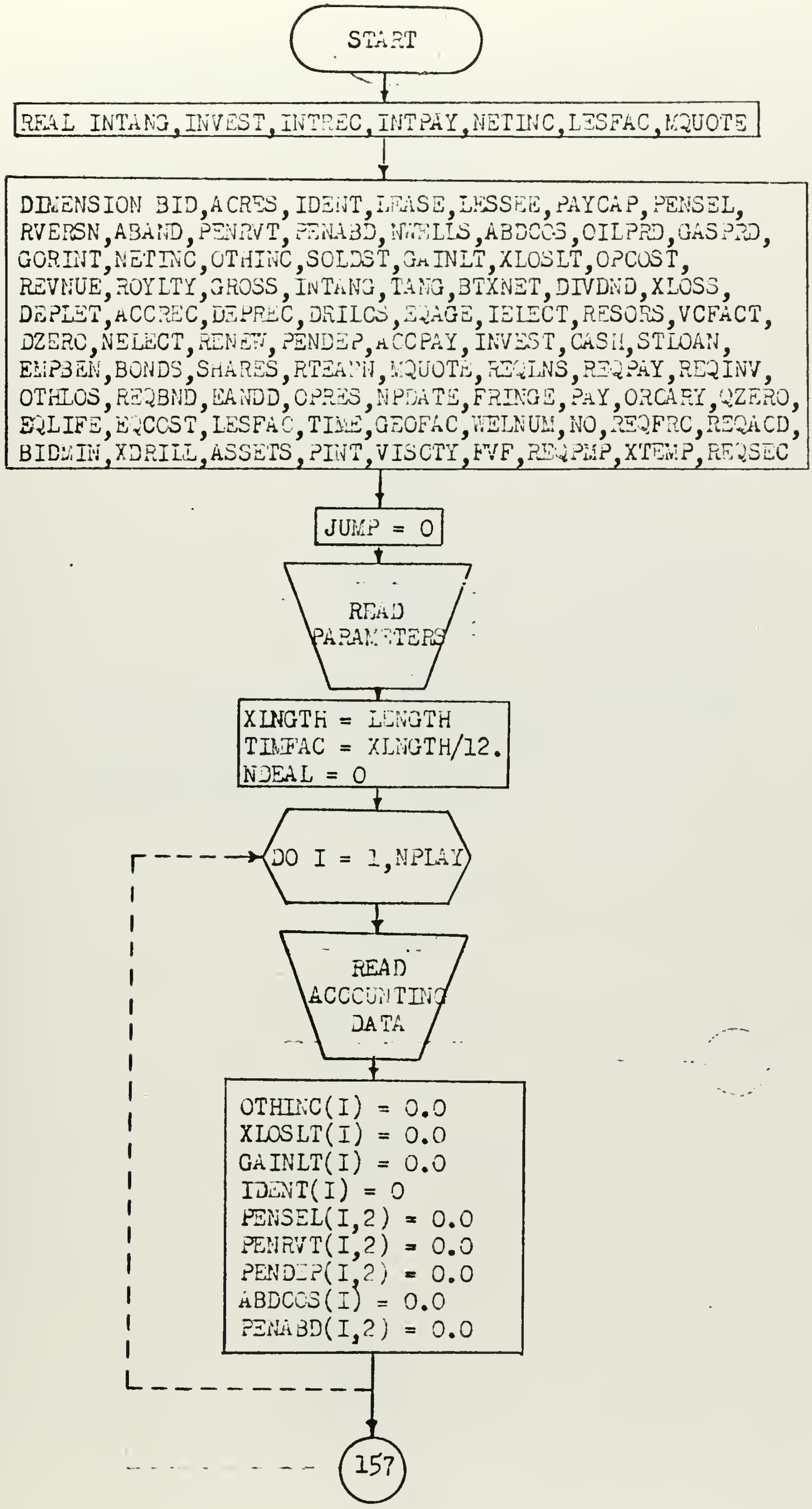
| | |
|---|---|
| Oil Wells: | |
| Currently being produced: | |
| Flowing: | 3. |
| Pumping: | 0. |
| Gas Lift: | 0. |
| Wells that have produced oil: | |
| Shut in: | 0. |
| Plugged and abandoned: | 0. |
| Converted to gas wells: | 0. |
| Gas Wells: | |
| Producing: | 0. |
| Shut in: | 0. |
| Dry and abandoned: | 0. |
| Total wells drilled: | 3. |

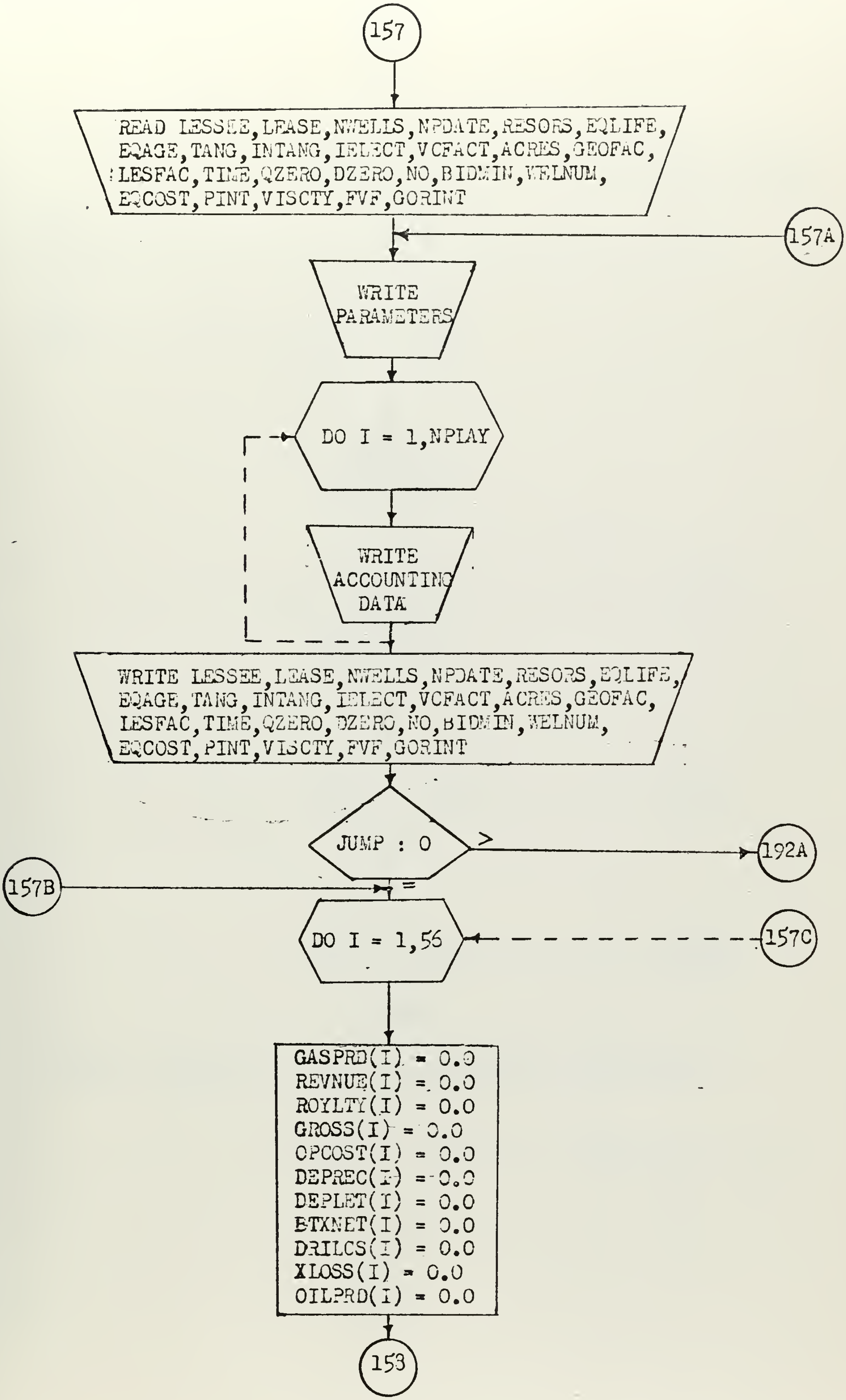
| | | |
|---|---|---|
| Production to date: | | |
| Oil Production: | 180,000. | |
| Water Production: | 1,000. | |
| Gas Production: | | |
| Gas produced from oil: | 120,000. | (MSCF) |
| Dry Gas: | 0. | |
| Total gas produced: | 120,000. | |
| Reservoir Data: | | |
| Initial reservoir pressure: | 1710. | |
| Present estimated reservoir pressure: | 1675. | |
| Saturation pressure: | 1660. | |
| Oil A.P.I. gravity: | 34° | |
| Sulphur percentage: | 1.0 | |
| Royalty Interest: | | |
| Owner: | 12.5% | |
| Other: | 0.0 | |
| Undepreciated tangible assets on lease: | | |
| Estimated Reserves: | 1,000,000. | |
| Minimum Bid: | $750,000. | |

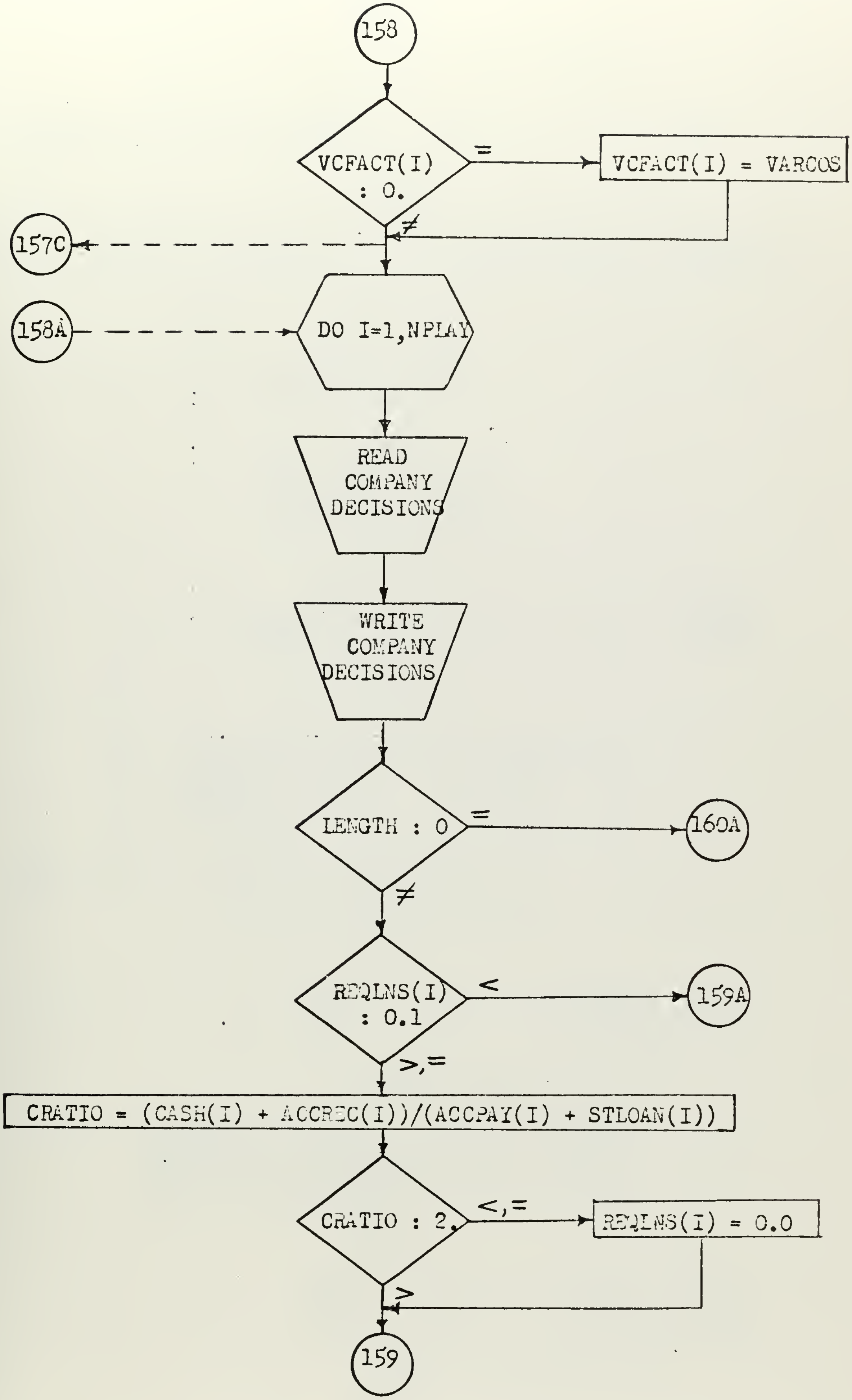
# APPENDIXES

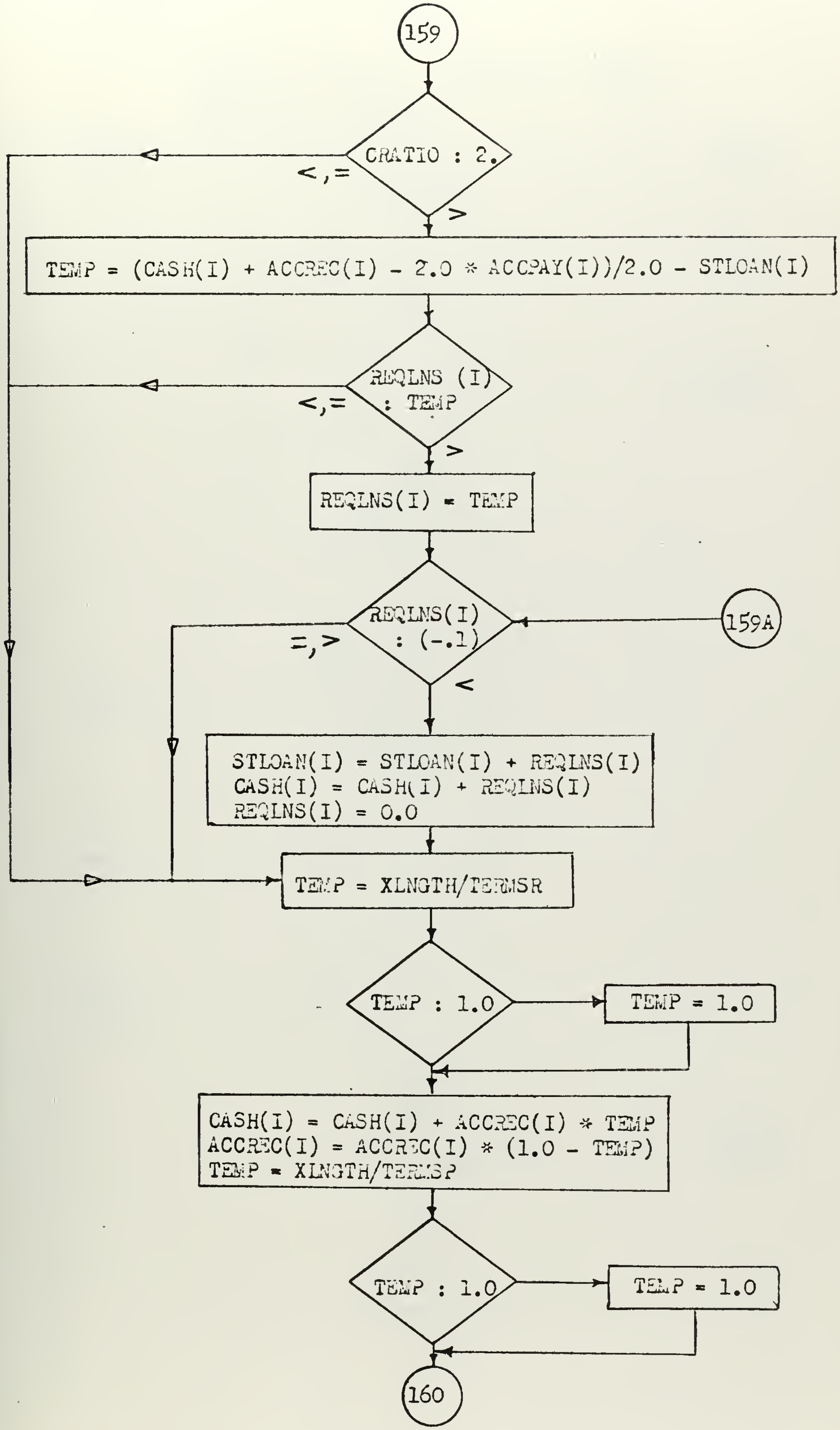
# APPENDIX A

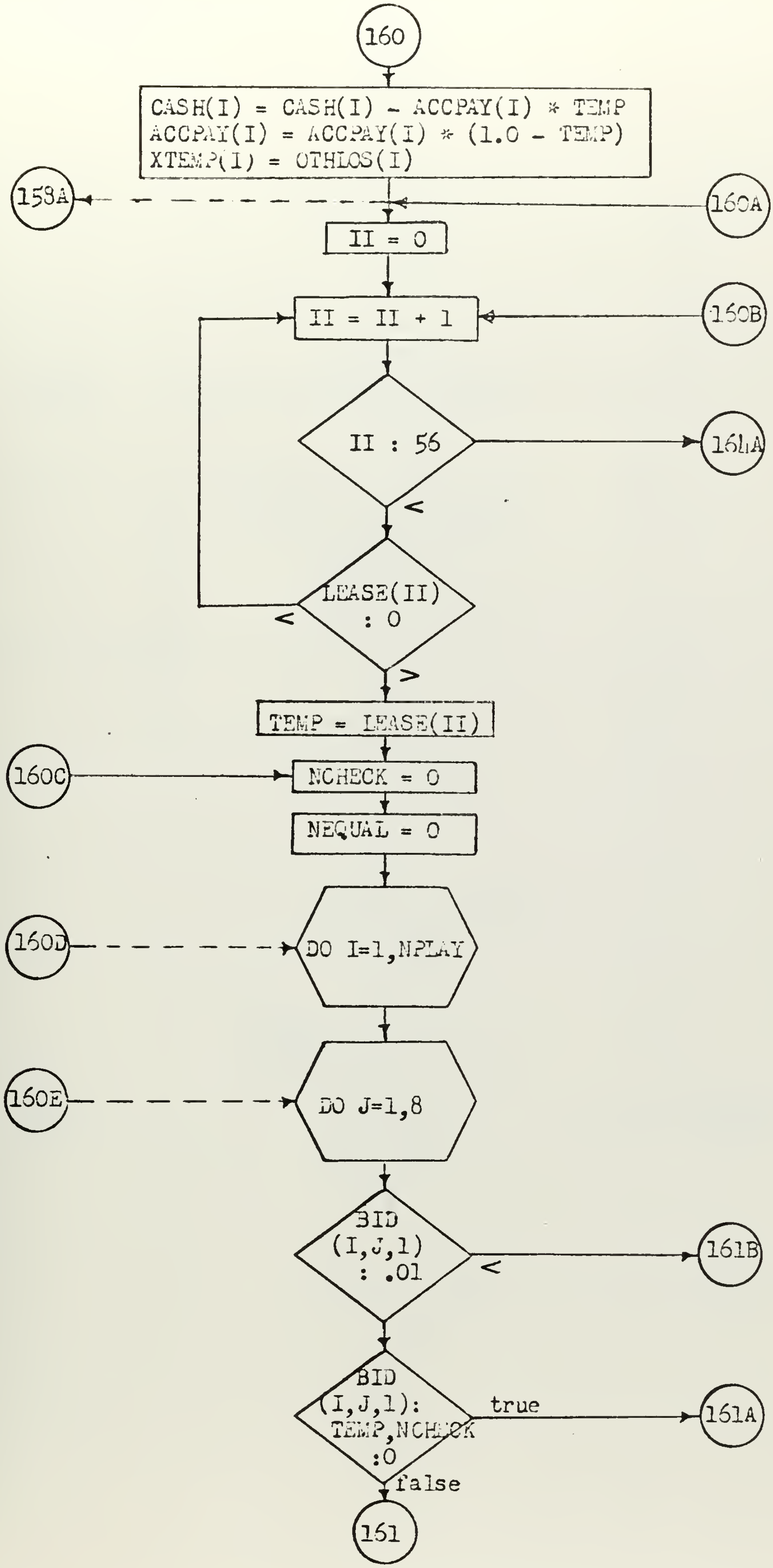
## Flow Charts

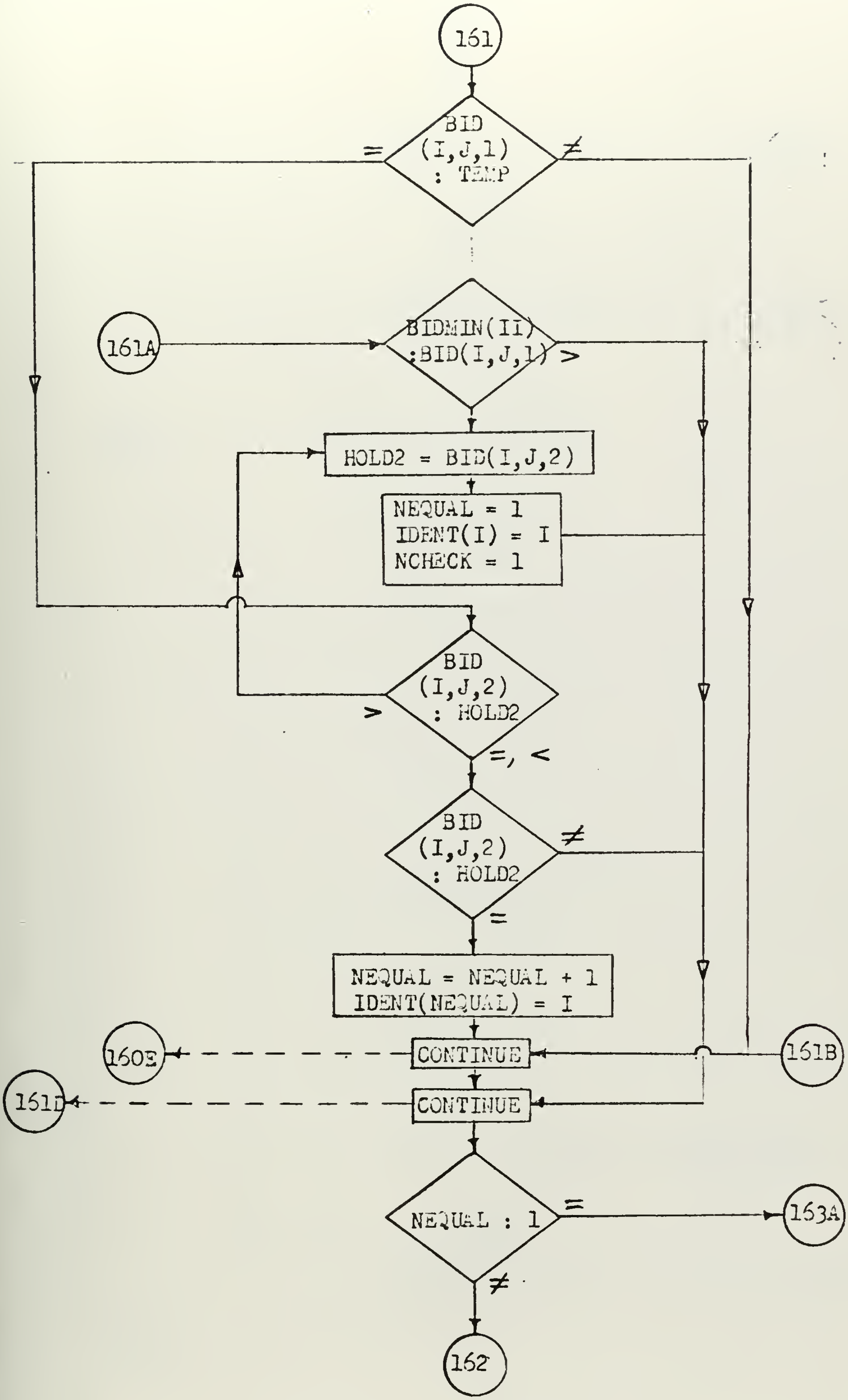

START
REAL INTANG,INVEST,INTREC,INTPAY,NETINC,LESFAC,MQUOTE
DIMENSION BID,ACRES,IDENT,LEASE,LESSEE,PAYCAP,PENSEL, RVERSN,ABAND,PENRVT,PENABD,NWELLS,ABDCOS,OILPRD,GASPRD, GORINT,NETINC,OTHINC,SOLDST,GAINLT,XLOSLT,OPCOST, REVNUE,ROYLTY,GROSS,INTANG,TANG,BTXNET,DIVDND,XLOSS, DEPLET,ACCREC,DEPREC,DRILCS,EQAGE,IELECT,RESORS,VCFACT, DZERO,NELECT,RENEW,PENDEP,ACCPAY,INVEST,CASH,STLOAN, EMPBEN,BONDS,SHARES,RTEARN,MQUOTE,REQLNS,REQPAY,REQINV, OTHLOS,REQBND,EANDD,OPRES,NPDATE,FRINGE,PAY,ORCARY,QZERO, EQLIFE,EQCOST,LESFAC,TIME,GEOFAC,WELNUM,NO,REQFRC,REQACD, BIDMIN,XDRILL,ASSETS,PINT,VISCTY,FVF,REQPMP,XTEMP,REQSEC
JUMP = 0
READ PARAMETERS
XLNGTH = LENGTH
TIMFAC = XLNGTH/12.
NDEAL = 0
DO I = 1,NPLAY
READ ACCOUNTING DATA
OTHINC(I) = 0.0
XLOSLT(I) = 0.0
GAINLT(I) = 0.0
IDENT(I) = 0
PENSEL(I,2) = 0.0
PENRVT(I,2) = 0.0
PENDEP(I,2) = 0.0
ABDCOS(I) = 0.0
PENABD(I,2) = 0.0
157


157
READ LESSEE,LEASE,NWELLS,NPDATE,RESORS,EQLIFE,
EQAGE,TANG,INTANG,IELECT,VCFACT,ACRES,GEOFAC,
LESFAC,TIME,QZERO,DZERO,NO,BIDMIN,WELNUM,
EQCOST,PINT,VISCTY,FVF,GORINT
157A
WRITE
PARAMETERS
DO I = 1,NPLAY
WRITE
ACCOUNTING
DATA
WRITE LESSEE,LEASE,NWELLS,NPDATE,RESORS,EQLIFE,
EQAGE,TANG,INTANG,IELECT,VCFACT,ACRES,GEOFAC,
LESFAC,TIME,QZERO,DZERO,NO,BIDMIN,WELNUM,
EQCOST,PINT,VISCTY,FVF,GORINT
JUMP : 0
>
192A
157B
=
DO I = 1,56
157C
GASPRD(I) = 0.0
REVNUE(I) = 0.0
ROYLTY(I) = 0.0
GROSS(I) = 0.0
OPCOST(I) = 0.0
DEPREC(I) = 0.0
DEPLET(I) = 0.0
BTXNET(I) = 0.0
DRILCS(I) = 0.0
XLOSS(I) = 0.0
OILPRD(I) = 0.0
153

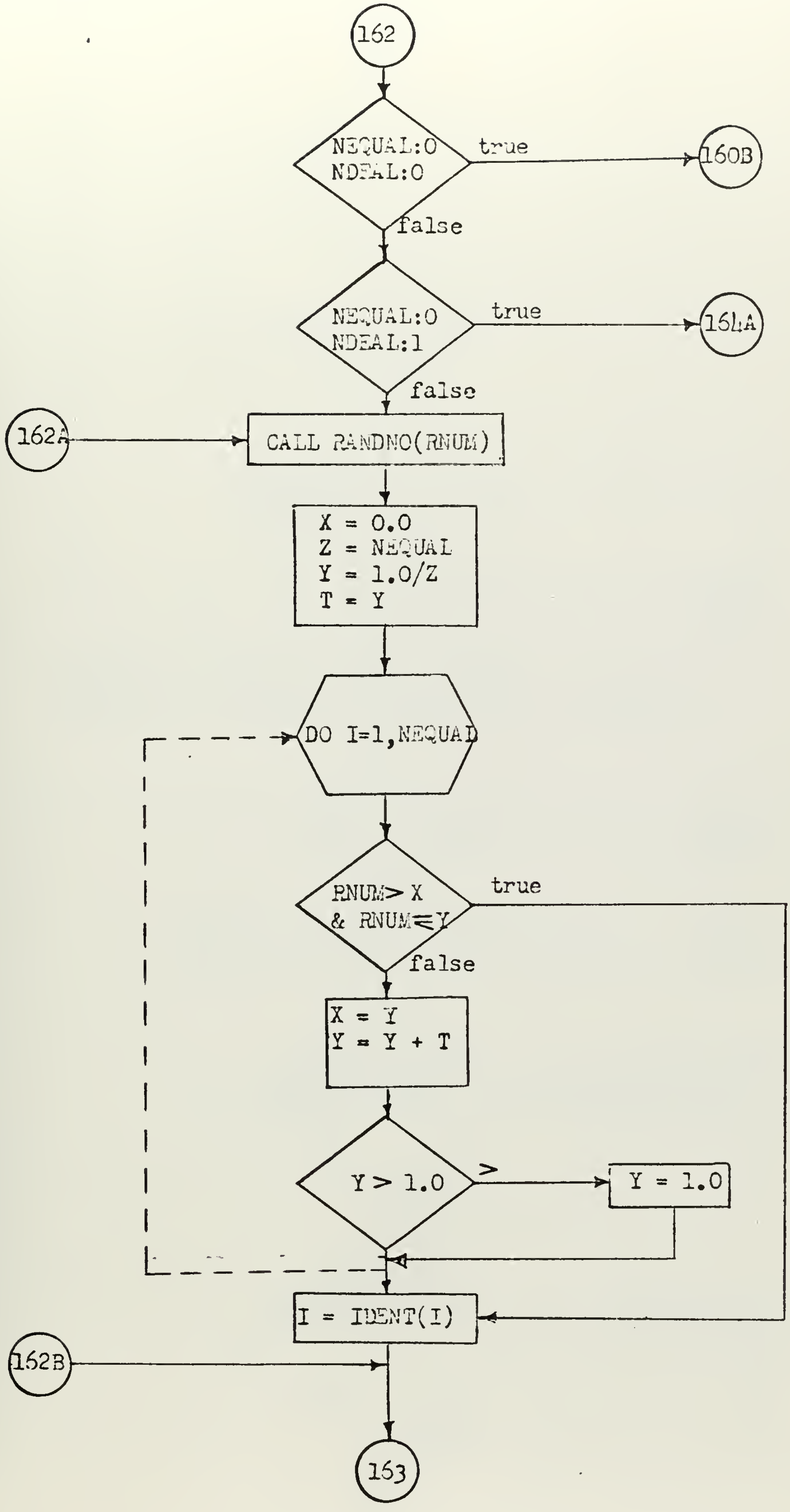

158
VCFACT(I) : 0.
=
VCFACT(I) = VARCOS
≠
157C
158A
DO I=1,NPLAY
READ COMPANY DECISIONS
WRITE COMPANY DECISIONS
LENGTH : 0
=
160A
≠
REQLNS(I) : 0.1
<
159A
>,=
CRATIO = (CASH(I) + ACCREC(I))/(ACCPAY(I) + STLOAN(I))
CRATIO : 2.
<,=
REQLNS(I) = 0.0
>
159

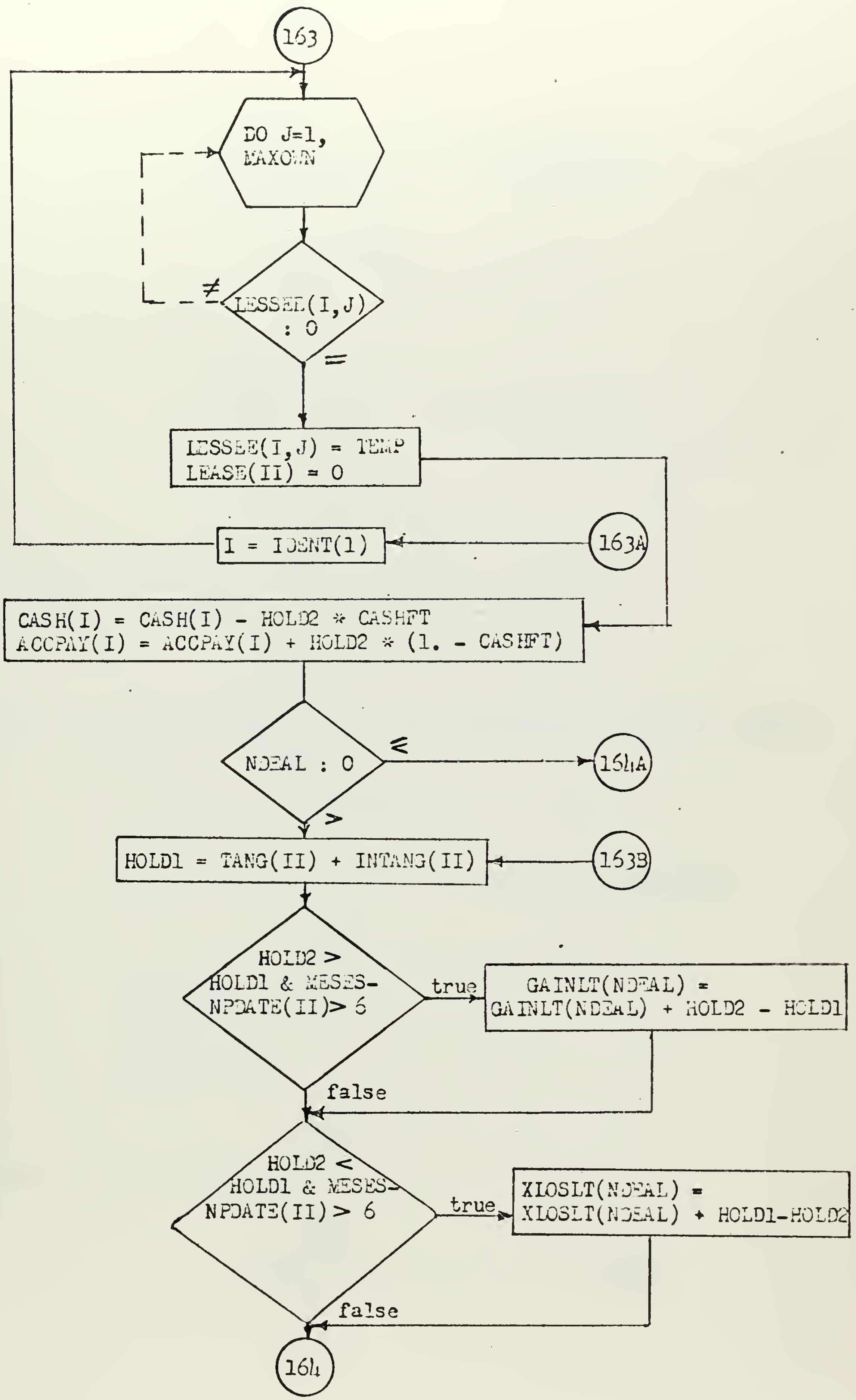

159
CRATIO : 2.
<,=
>
TEMP = (CASH(I) + ACCREC(I) - 2.0 * ACCPAY(I))/2.0 - STLOAN(I)
REQLNS (I) : TEMP
<,=
>
REQLNS(I) = TEMP
REQLNS(I) : (-.1)
=,>
<
159A
STLOAN(I) = STLOAN(I) + REQLNS(I)
CASH(I) = CASH(I) + REQLNS(I)
REQLNS(I) = 0.0
TEMP = XLNGTH/TERMSR
TEMP : 1.0
TEMP = 1.0
CASH(I) = CASH(I) + ACCREC(I) * TEMP
ACCREC(I) = ACCREC(I) * (1.0 - TEMP)
TEMP = XLNGTH/TERMSP
TEMP : 1.0
TEMP = 1.0
160

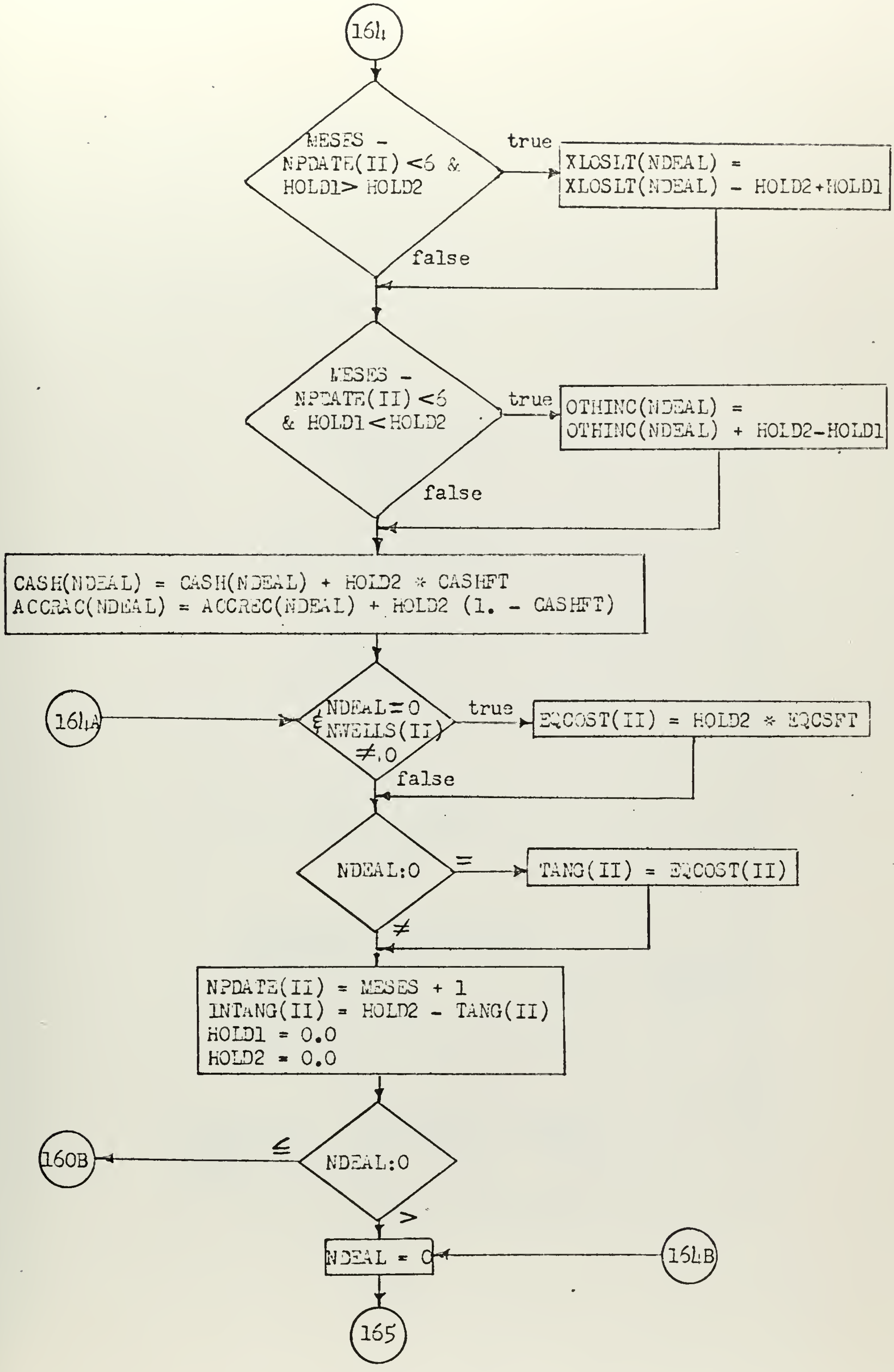

160
CASH(I) = CASH(I) - ACCPAY(I) * TEMP
ACCPAY(I) = ACCPAY(I) * (1.0 - TEMP)
XTEMP(I) = OTHLOS(I)
158A
160A
II = 0
II = II + 1
160B
II : 56
164A
<
LEASE(II) : 0
<
>
TEMP = LEASE(II)
160C
NCHECK = 0
NEQUAL = 0
160D
DO I=1,NPLAY
160E
DO J=1,8
BID (I,J,1) : .01
<
161B
BID (I,J,1): TEMP,NCHECK :0
true
161A
false
161

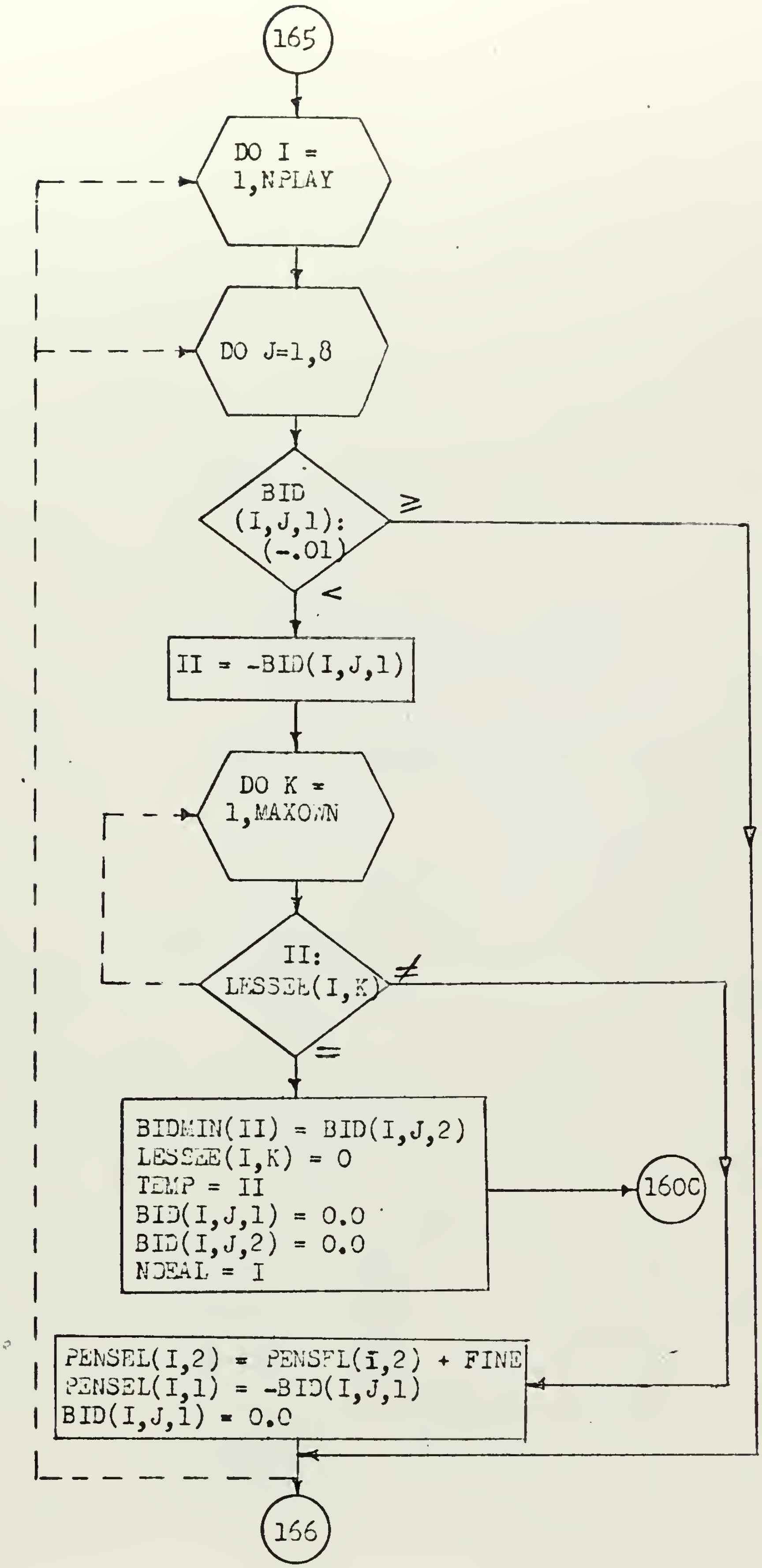


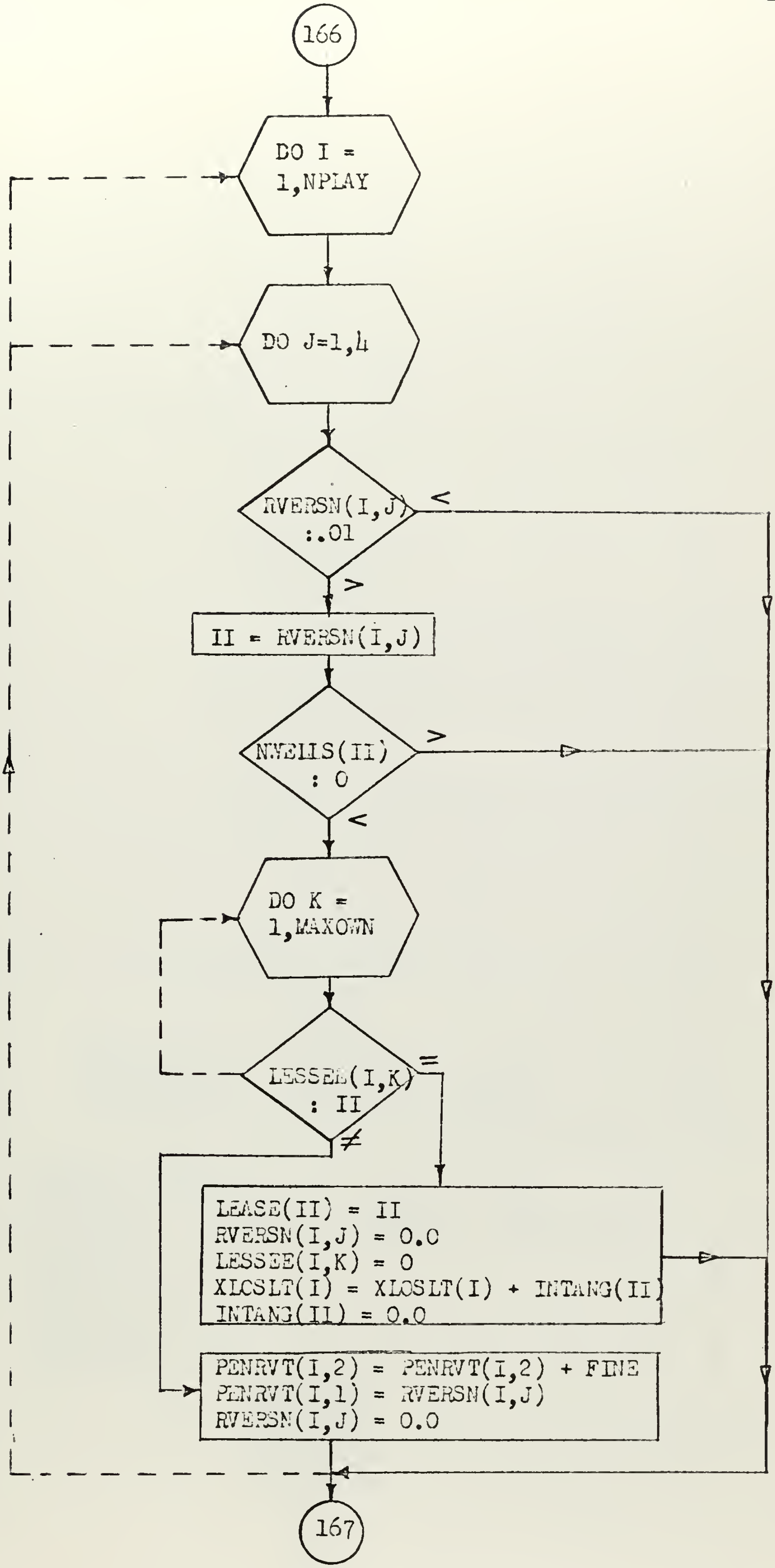
161
BID (I,J,1) : TEMP
=
≠
161A
BIDMIN(II) :BID(I,J,1)
>
HOLD2 = BID(I,J,2)
NEQUAL = 1
IDENT(I) = I
NCHECK = 1
BID (I,J,2) : HOLD2
>
=, <
BID (I,J,2) : HOLD2
≠
=
NEQUAL = NEQUAL + 1
IDENT(NEQUAL) = I
160E
CONTINUE
161B
161D
CONTINUE
NEQUAL : 1
=
163A
≠
162

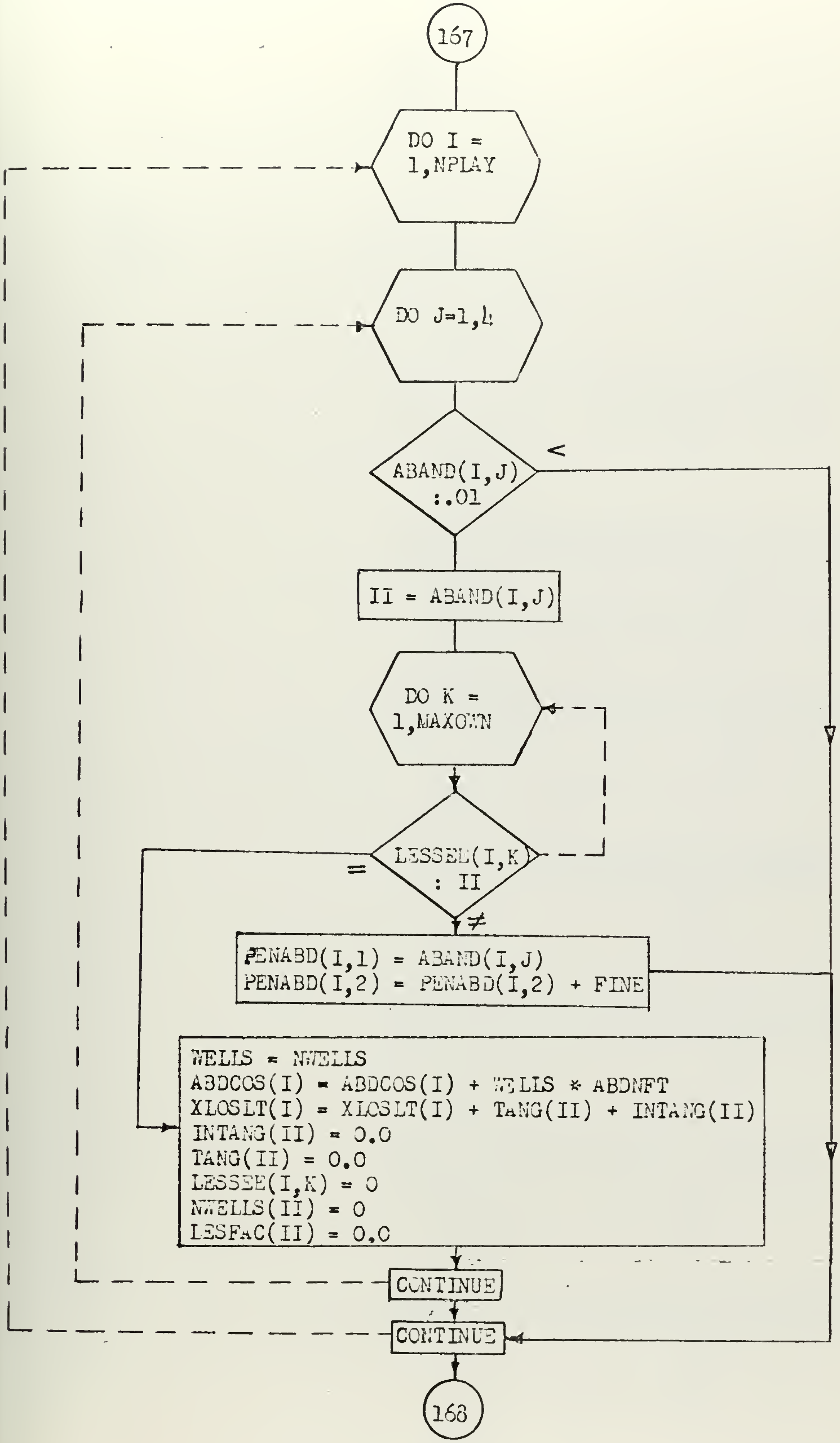

162
NEQUAL:0
NDEAL:0
true
160B
false
NEQUAL:0
NDEAL:1
true
164A
false
162A
CALL RANDNO(RNUM)
X = 0.0
Z = NEQUAL
Y = 1.0/Z
T = Y
DO I=1,NEQUAL
RNUM > X
& RNUM ≤ Y
true
false
X = Y
Y = Y + T
Y > 1.0
>
Y = 1.0
I = IDENT(I)
162B
163

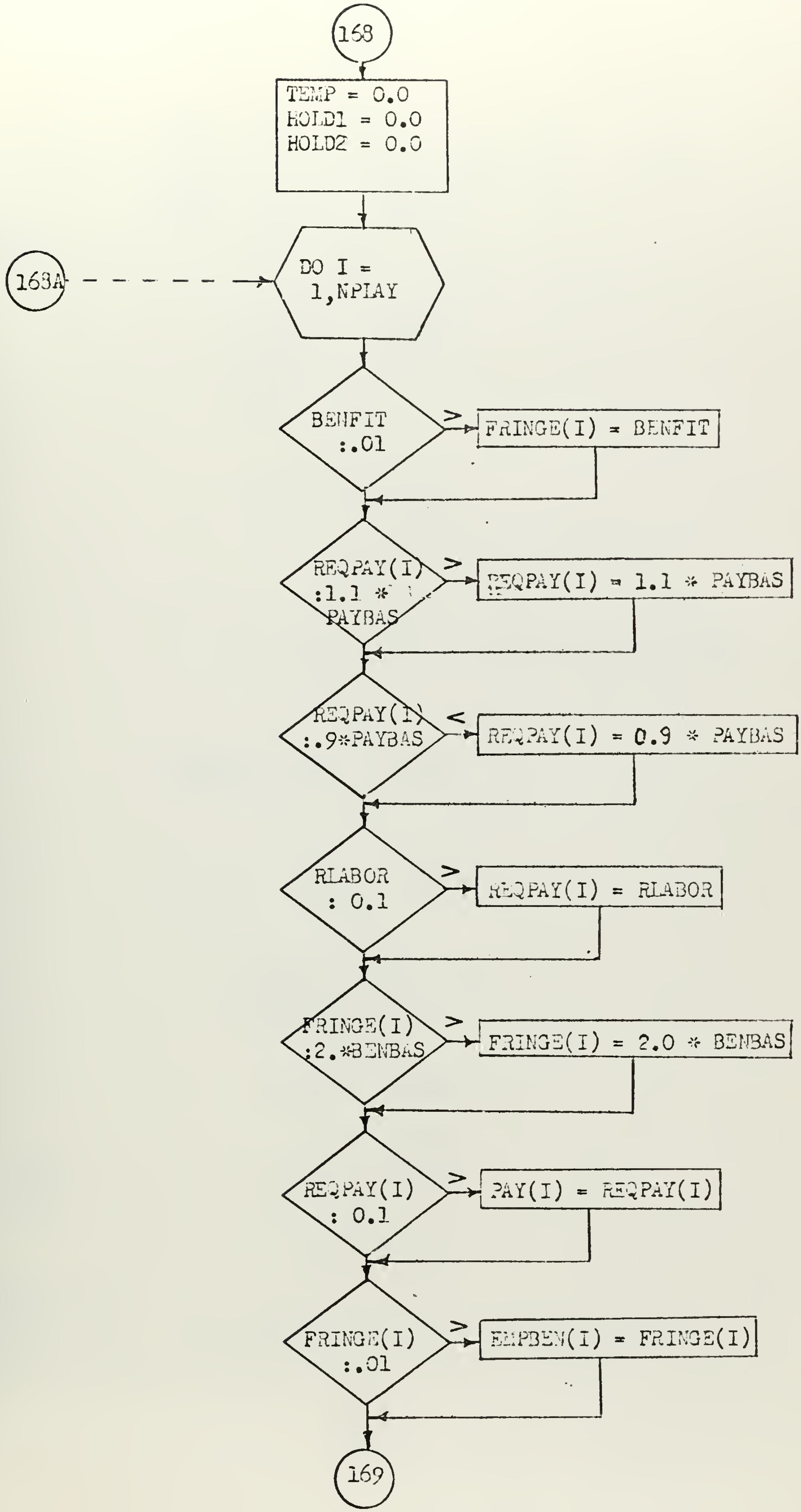

163
DO J=1, MAXOWN
≠
LESSEE(I,J) : 0
=
LESSEE(I,J) = TEMP
LEASE(II) = 0
I = IDENT(1)
163A
CASH(I) = CASH(I) - HOLD2 * CASHFT
ACCPAY(I) = ACCPAY(I) + HOLD2 * (1. - CASHFT)
NDEAL : 0
≤
164A
>
HOLD1 = TANG(II) + INTANG(II)
163B
HOLD2 > HOLD1 & MESES-NPDATE(II) > 6
true
GAINLT(NDEAL) = GAINLT(NDEAL) + HOLD2 - HOLD1
false
HOLD2 < HOLD1 & MESES-NPDATE(II) > 6
true
XLOSLT(NDEAL) = XLOSLT(NDEAL) + HOLD1-HOLD2
false
164


164
MESES - NPDATE(II) <6 & HOLD1> HOLD2
true
XLOSLT(NDEAL) = XLOSLT(NDEAL) - HOLD2+HOLD1
false
MESES - NPDATE(II) <6 & HOLD1 < HOLD2
true
OTHINC(NDEAL) = OTHINC(NDEAL) + HOLD2-HOLD1
false
CASH(NDEAL) = CASH(NDEAL) + HOLD2 * CASHFT
ACCRAC(NDEAL) = ACCREC(NDEAL) + HOLD2 (1. - CASHFT)
164A
NDEAL = 0 & NWELLS(II) ≠ 0
true
EQCOST(II) = HOLD2 * EQCSFT
false
NDEAL:0
=
TANG(II) = EQCOST(II)
≠
NPDATE(II) = MESES + 1
INTANG(II) = HOLD2 - TANG(II)
HOLD1 = 0.0
HOLD2 = 0.0
160B
≤
NDEAL:0
>
NDEAL = 0
164B
165

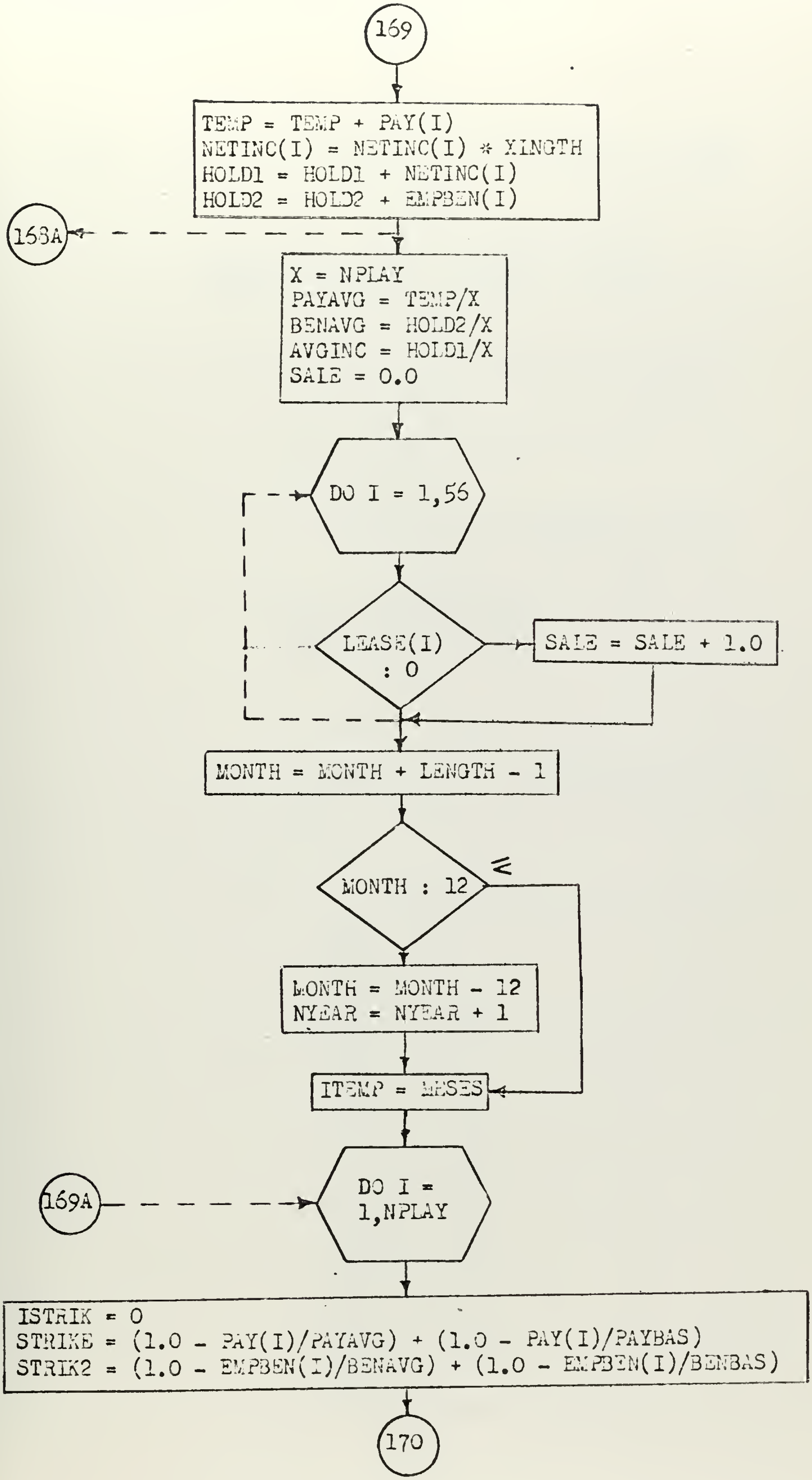

165
DO I = 1,NPLAY
DO J=1,8
BID (I,J,1): (-.01)
≥
<
II = -BID(I,J,1)
DO K = 1,MAXOWN
II: LESSEE(I,K)
≠
=
BIDMIN(II) = BID(I,J,2)
LESSEE(I,K) = 0
TEMP = II
BID(I,J,1) = 0.0
BID(I,J,2) = 0.0
NDEAL = I
160C
PENSEL(I,2) = PENSEL(I,2) + FINE
PENSEL(I,1) = -BID(I,J,1)
BID(I,J,1) = 0.0
166

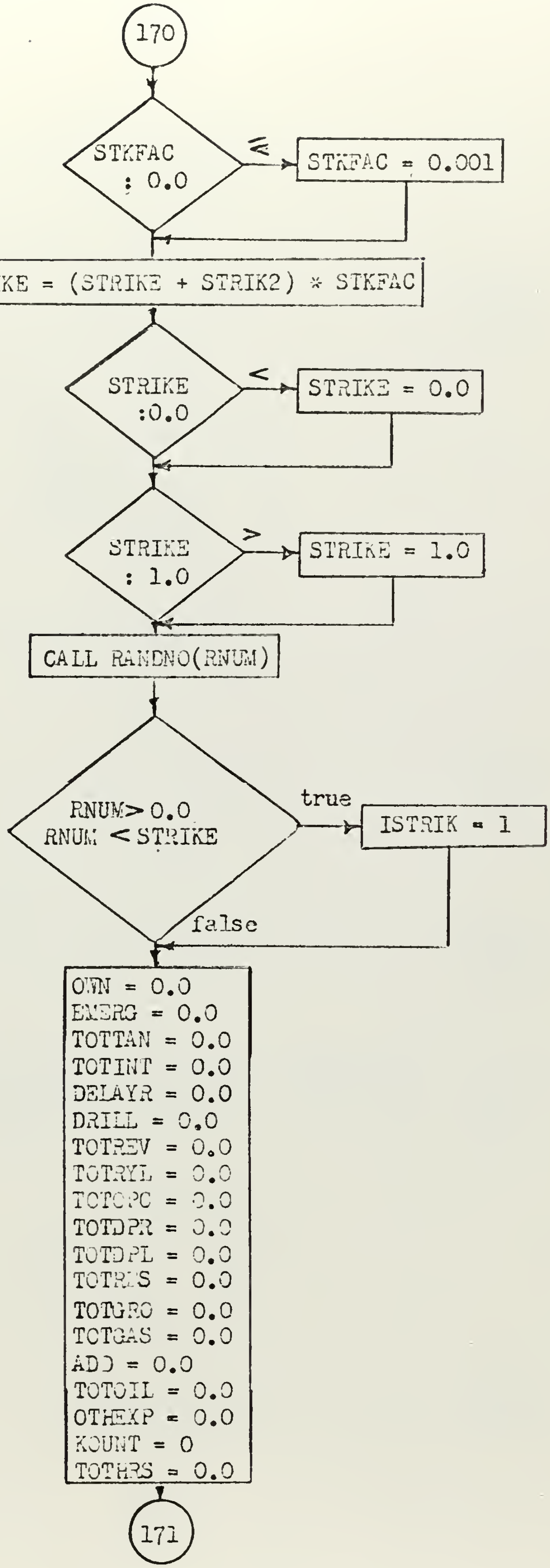

166
DO I = 1,NPLAY
DO J=1,4
RVERSN(I,J) :.01
<
>
II = RVERSN(I,J)
NWELLS(II) : 0
>
<
DO K = 1,MAXOWN
LESSEE(I,K) : II
=
≠
LEASE(II) = II
RVERSN(I,J) = 0.0
LESSEE(I,K) = 0
XLOSLT(I) = XLOSLT(I) + INTANG(II)
INTANG(II) = 0.0
PENRVT(I,2) = PENRVT(I,2) + FINE
PENRVT(I,1) = RVERSN(I,J)
RVERSN(I,J) = 0.0
167

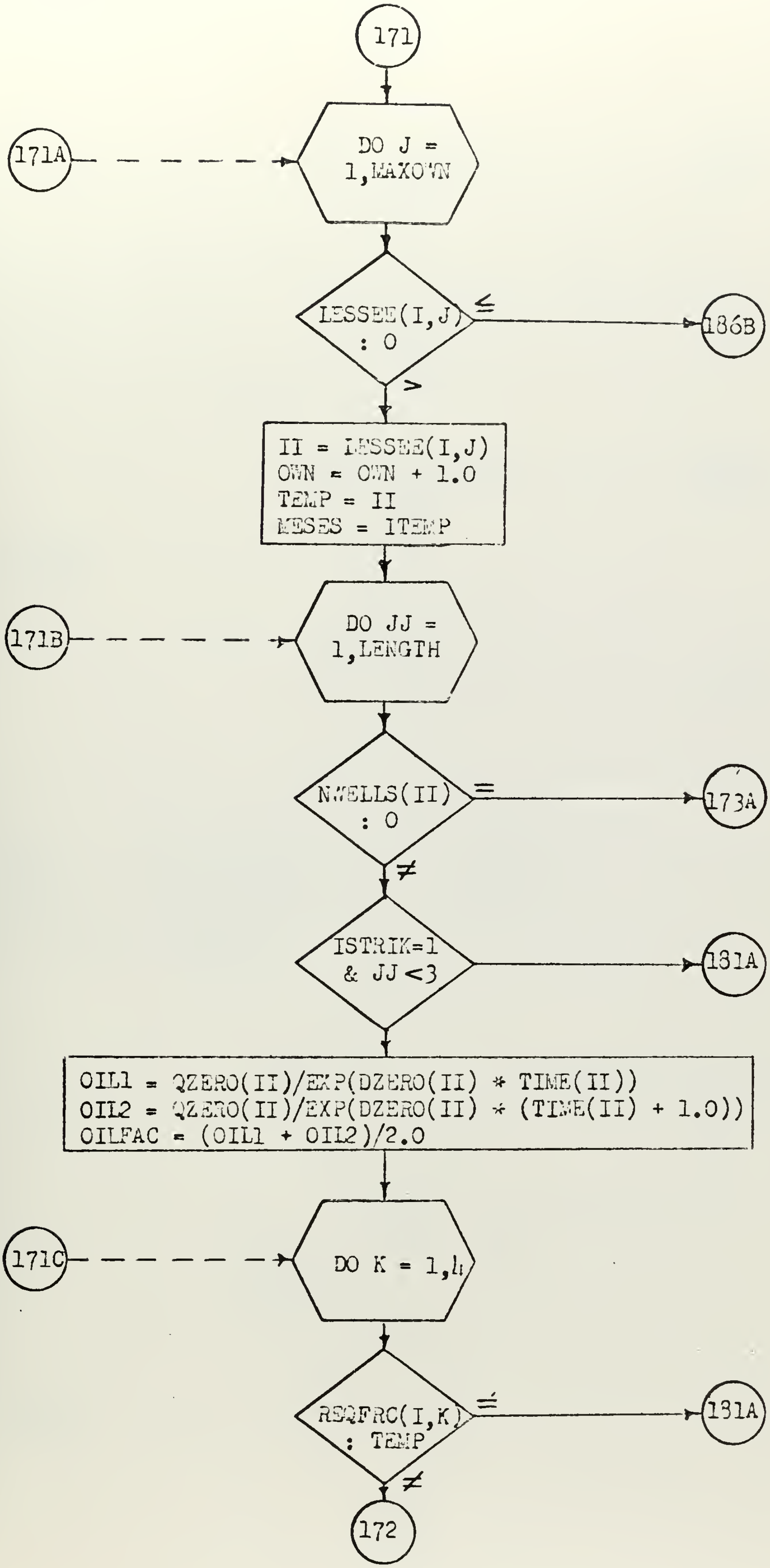

167
DO I =
1,NPLAY
DO J=1,4
ABAND(I,J)
:.01
<
II = ABAND(I,J)
DO K =
1,MAXOWN
LESSEE(I,K)
: II
=
≠
PENABD(I,1) = ABAND(I,J)
PENABD(I,2) = PENABD(I,2) + FINE
WELLS = NWELLS
ABDCOS(I) = ABDCOS(I) + WELLS * ABDNFT
XLOSLT(I) = XLOSLT(I) + TANG(II) + INTANG(II)
INTANG(II) = 0.0
TANG(II) = 0.0
LESSEE(I,K) = 0
NWELLS(II) = 0
LESFAC(II) = 0.0
CONTINUE
CONTINUE
168

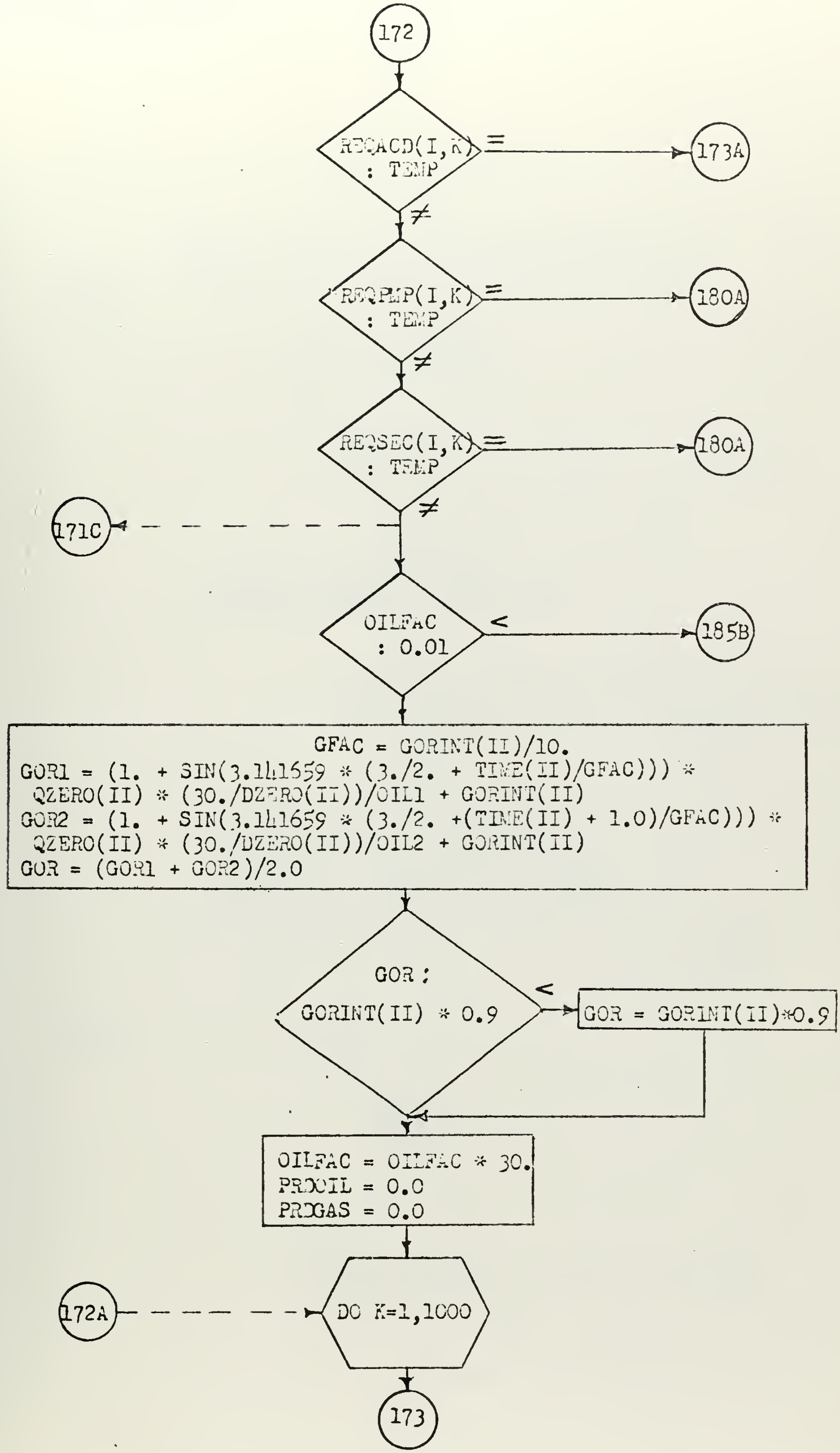


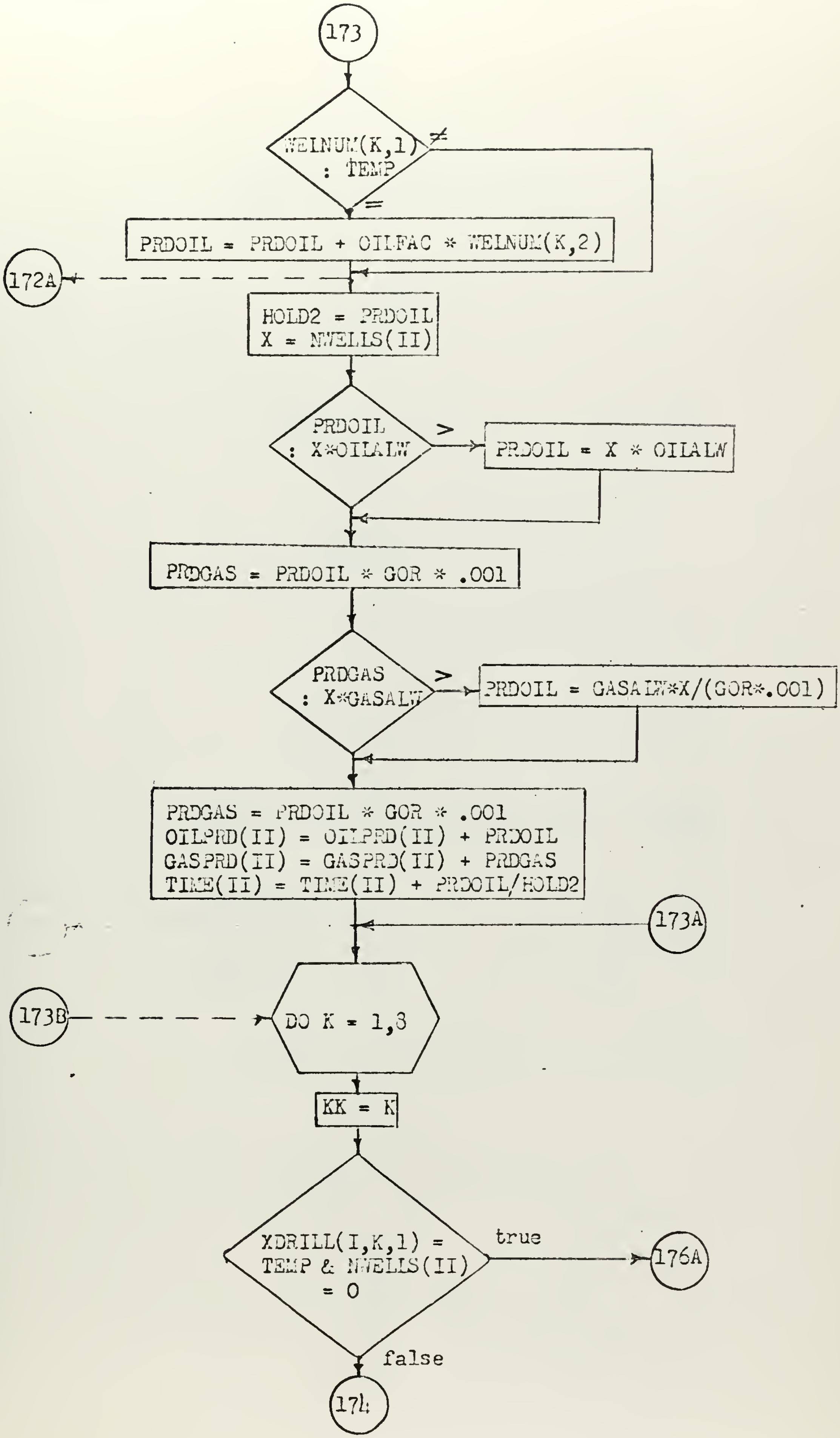
168
TEMP = 0.0
HOLD1 = 0.0
HOLD2 = 0.0
168A
DO I = 1,NPLAY
BENFIT :.01
>
FRINGE(I) = BENFIT
REQPAY(I) :1.1 * PAYBAS
>
REQPAY(I) = 1.1 * PAYBAS
REQPAY(I) :.9*PAYBAS
<
REQPAY(I) = 0.9 * PAYBAS
RLABOR : 0.1
>
REQPAY(I) = RLABOR
FRINGE(I) :2.*BENBAS
>
FRINGE(I) = 2.0 * BENBAS
REQPAY(I) : 0.1
>
PAY(I) = REQPAY(I)
FRINGE(I) :.01
>
EMPBEN(I) = FRINGE(I)
169


169
TEMP = TEMP + PAY(I)
NETINC(I) = NETINC(I) * XINGTH
HOLD1 = HOLD1 + NETINC(I)
HOLD2 = HOLD2 + EMPBEN(I)
168A
X = NPLAY
PAYAVG = TEMP/X
BENAVG = HOLD2/X
AVGINC = HOLD1/X
SALE = 0.0
DO I = 1,56
LEASE(I) : 0
SALE = SALE + 1.0
MONTH = MONTH + LENGTH - 1
MONTH : 12
≤
MONTH = MONTH - 12
NYEAR = NYEAR + 1
ITEMP = LESES
169A
DO I = 1,NPLAY
ISTRIK = 0
STRIKE = (1.0 - PAY(I)/PAYAVG) + (1.0 - PAY(I)/PAYBAS)
STRIK2 = (1.0 - EMPBEN(I)/BENAVG) + (1.0 - EMPBEN(I)/BENBAS)
170

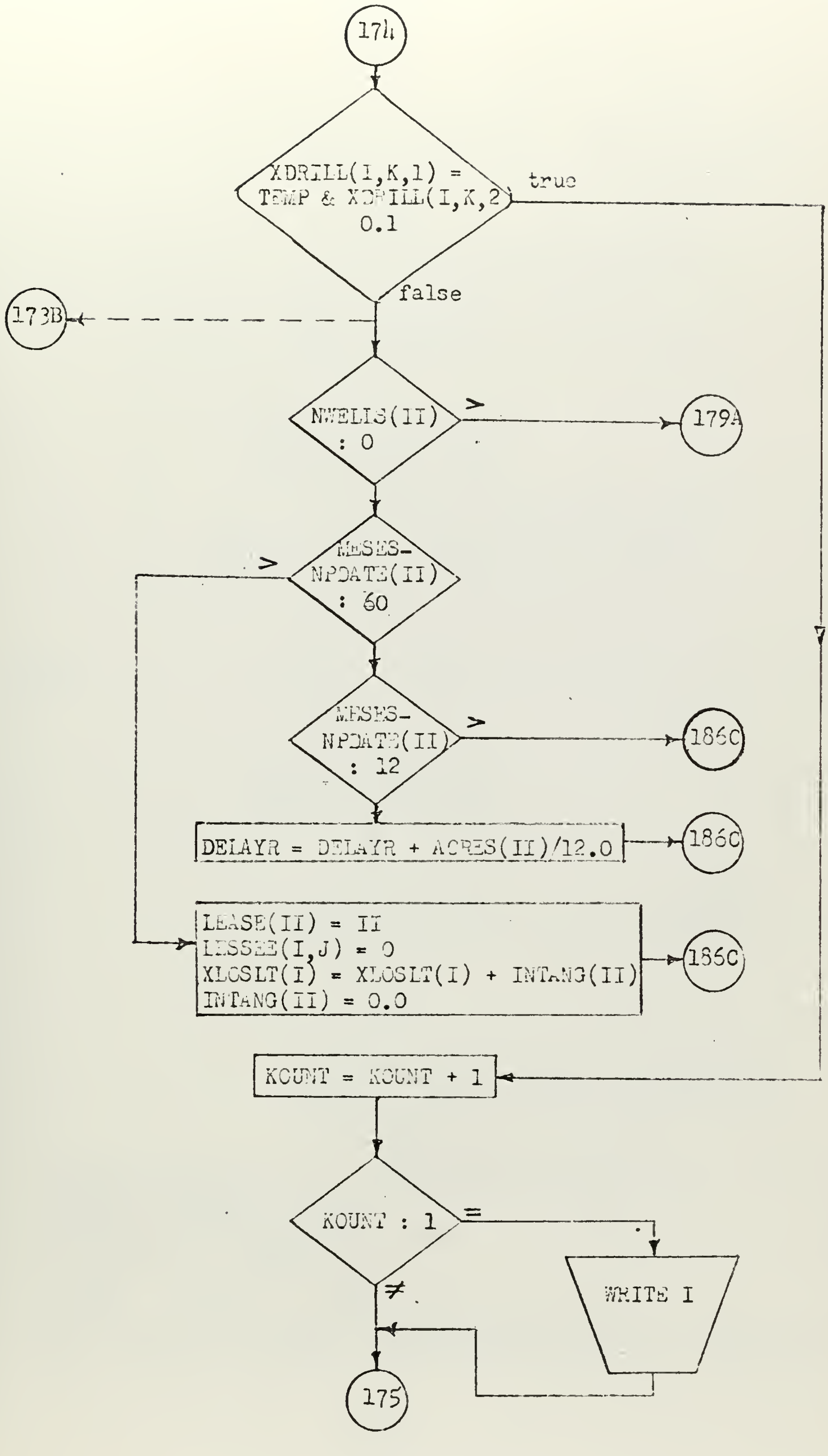

170
STKFAC : 0.0
≤
STKFAC = 0.001
STRIKE = (STRIKE + STRIK2) * STKFAC
STRIKE :0.0
<
STRIKE = 0.0
STRIKE : 1.0
>
STRIKE = 1.0
CALL RANDNO(RNUM)
RNUM> 0.0
RNUM < STRIKE
true
ISTRIK = 1
false
OWN = 0.0
EMERG = 0.0
TOTTAN = 0.0
TOTINT = 0.0
DELAYR = 0.0
DRILL = 0.0
TOTREV = 0.0
TOTRYL = 0.0
TOTOPC = 0.0
TOTDPR = 0.0
TOTDPL = 0.0
TOTRMS = 0.0
TOTGRO = 0.0
TOTGAS = 0.0
ADD = 0.0
TOTOIL = 0.0
OTHEXP = 0.0
KOUNT = 0
TOTHRS = 0.0
171

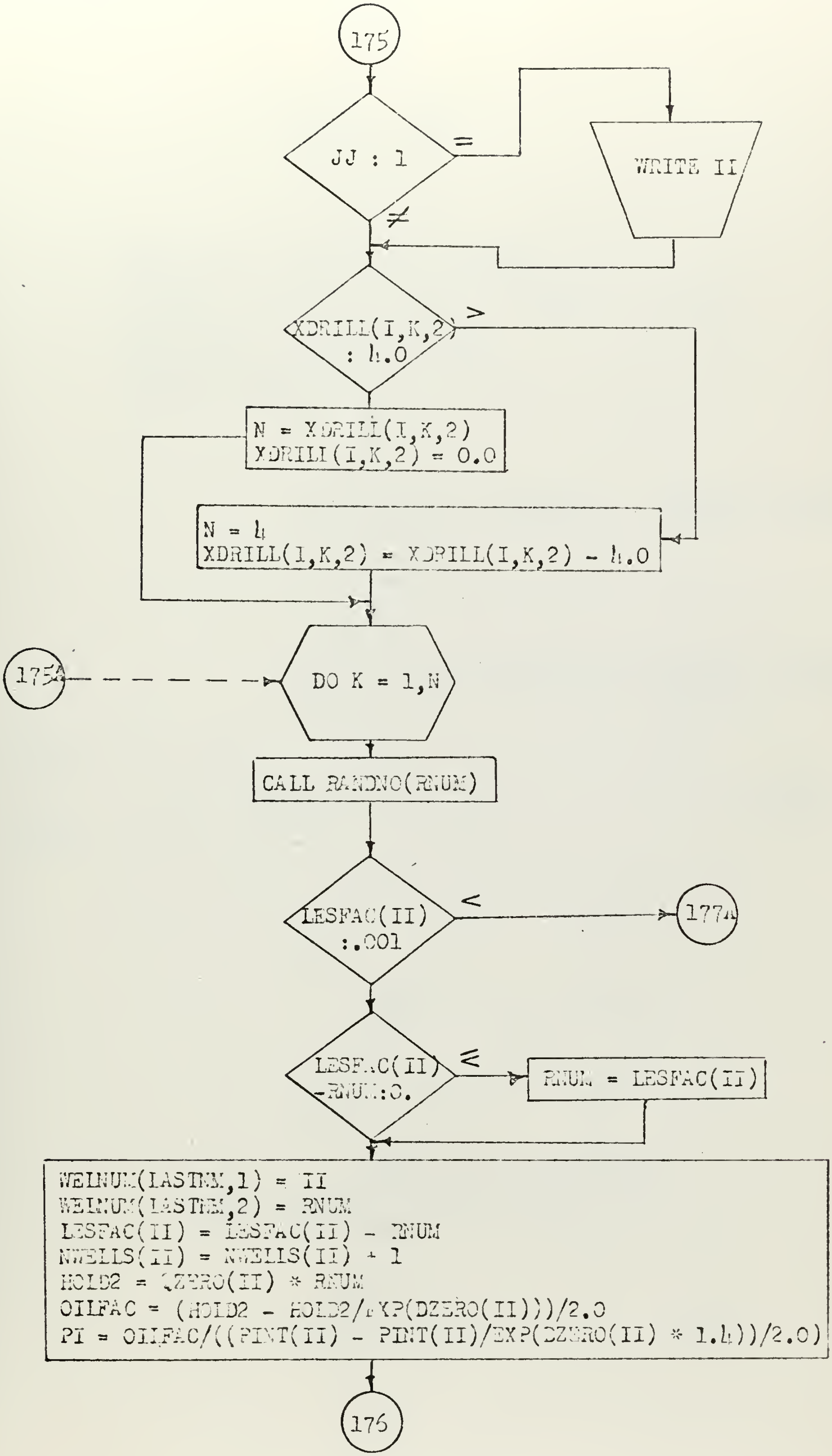

171
171A
DO J = 1,MAXOWN
LESSEE(I,J) : 0
≤
186B
>
II = LESSEE(I,J)
OWN = OWN + 1.0
TEMP = II
MESES = ITEMP
171B
DO JJ = 1,LENGTH
NWELLS(II) : 0
=
173A
≠
ISTRIK=1 & JJ <3
181A
OIL1 = QZERO(II)/EXP(DZERO(II) * TIME(II))
OIL2 = QZERO(II)/EXP(DZERO(II) * (TIME(II) + 1.0))
OILFAC = (OIL1 + OIL2)/2.0
171C
DO K = 1,4
REQFRC(I,K) : TEMP
≠
181A
≠
172

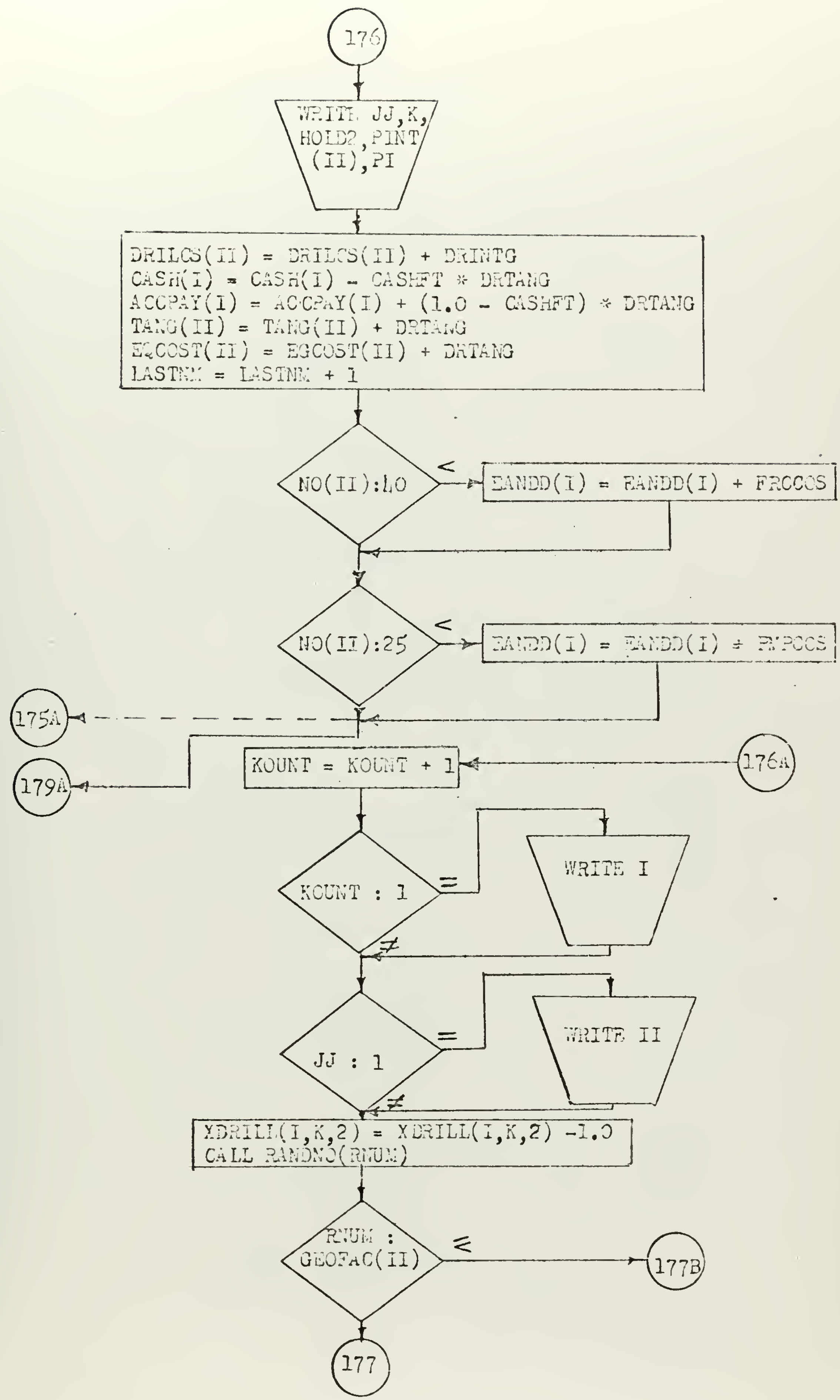

172
REQACD(I,K) : TEMP
=
173A
≠
REQPMP(I,K) : TEMP
=
180A
≠
REQSEC(I,K) : TEMP
=
180A
≠
171C
OILFAC : 0.01
<
185B
GFAC = GORINT(II)/10.
GOR1 = (1. + SIN(3.141659 * (3./2. + TIME(II)/GFAC))) * QZERO(II) * (30./DZERO(II))/OIL1 + GORINT(II)
GOR2 = (1. + SIN(3.141659 * (3./2. +(TIME(II) + 1.0)/GFAC))) * QZERO(II) * (30./DZERO(II))/OIL2 + GORINT(II)
GOR = (GOR1 + GOR2)/2.0
GOR : GORINT(II) * 0.9
<
GOR = GORINT(II)*0.9
OILFAC = OILFAC * 30.
PRDOIL = 0.0
PRDGAS = 0.0
172A
DO K=1,1000
173

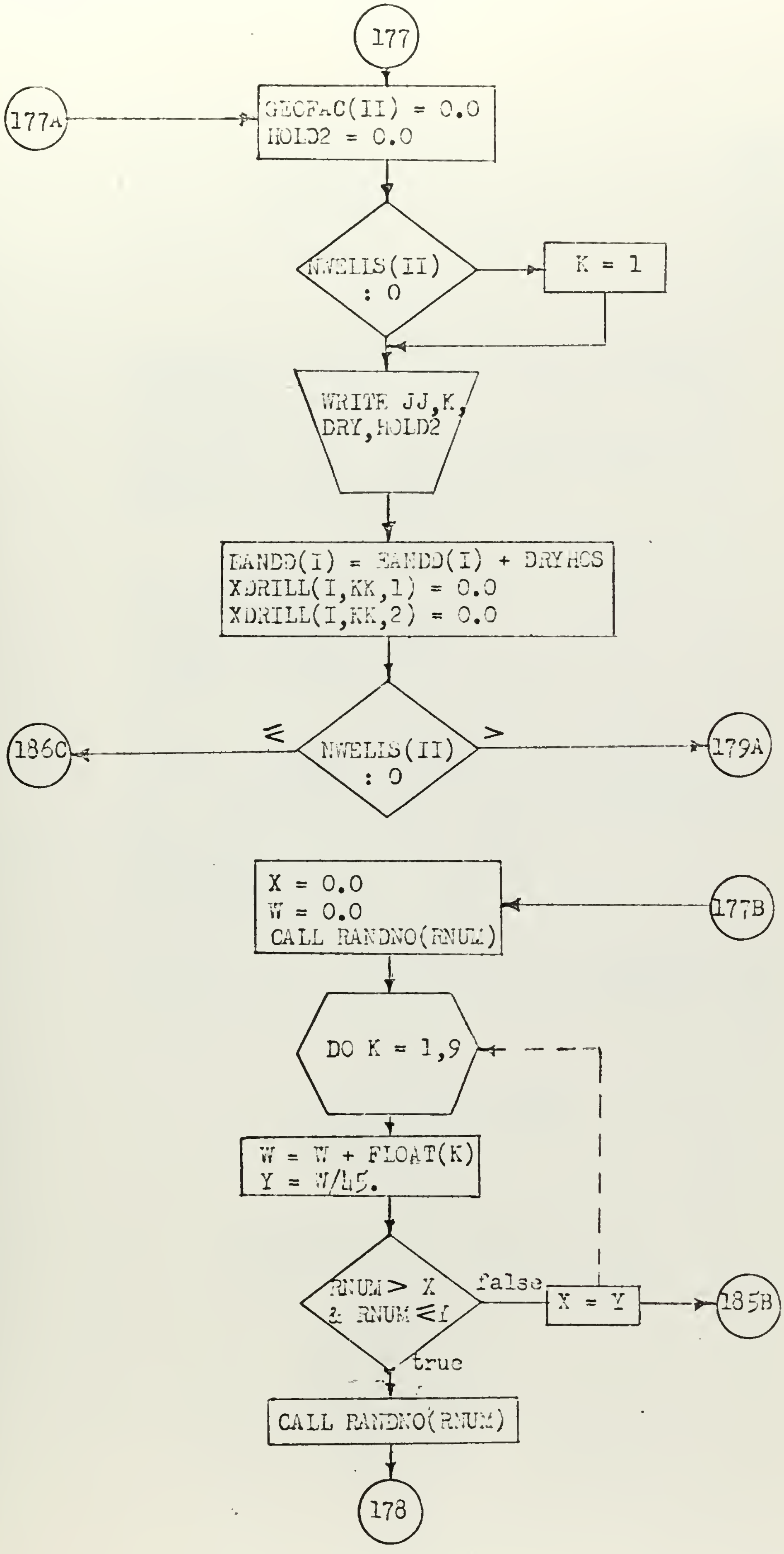


173
WELNUM(K,1) : TEMP
≠
=
PRDOIL = PRDOIL + OILFAC * WELNUM(K,2)
172A
HOLD2 = PRDOIL
X = NWELLS(II)
PRDOIL : X*OILALW
>
PRDOIL = X * OILALW
PRDGAS = PRDOIL * GOR * .001
PRDGAS : X*GASALW
>
PRDOIL = GASALW*X/(GOR*.001)
PRDGAS = PRDOIL * GOR * .001
OILPRD(II) = OILPRD(II) + PRDOIL
GASPRD(II) = GASPRD(II) + PRDGAS
TIME(II) = TIME(II) + PRDOIL/HOLD2
173A
173B
DO K = 1,8
KK = K
XDRILL(I,K,1) = TEMP & NWELLS(II) = 0
true
176A
false
174

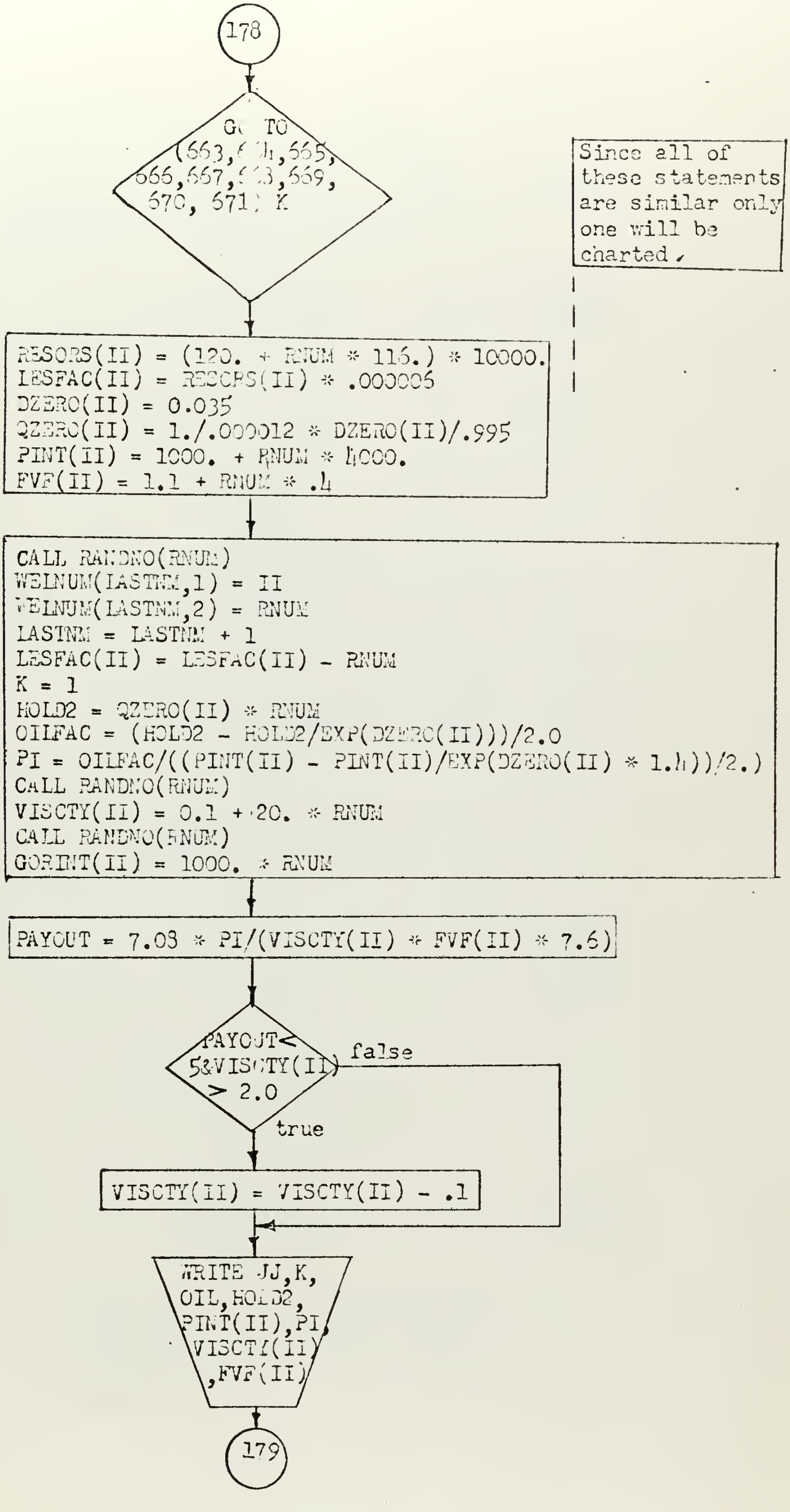

174
XDRILL(I,K,1) = TEMP & XDRILL(I,K,2) 0.1
true
false
173B
NWELLS(II) : 0
>
179A
MESES-NPDATE(II) : 60
>
MESES-NPDATE(II) : 12
>
186C
DELAYR = DELAYR + ACRES(II)/12.0
186C
LEASE(II) = II
LESSEE(I,J) = 0
XLOSLT(I) = XLOSLT(I) + INTANG(II)
INTANG(II) = 0.0
186C
KOUNT = KOUNT + 1
KOUNT : 1
=
WRITE I
≠
175

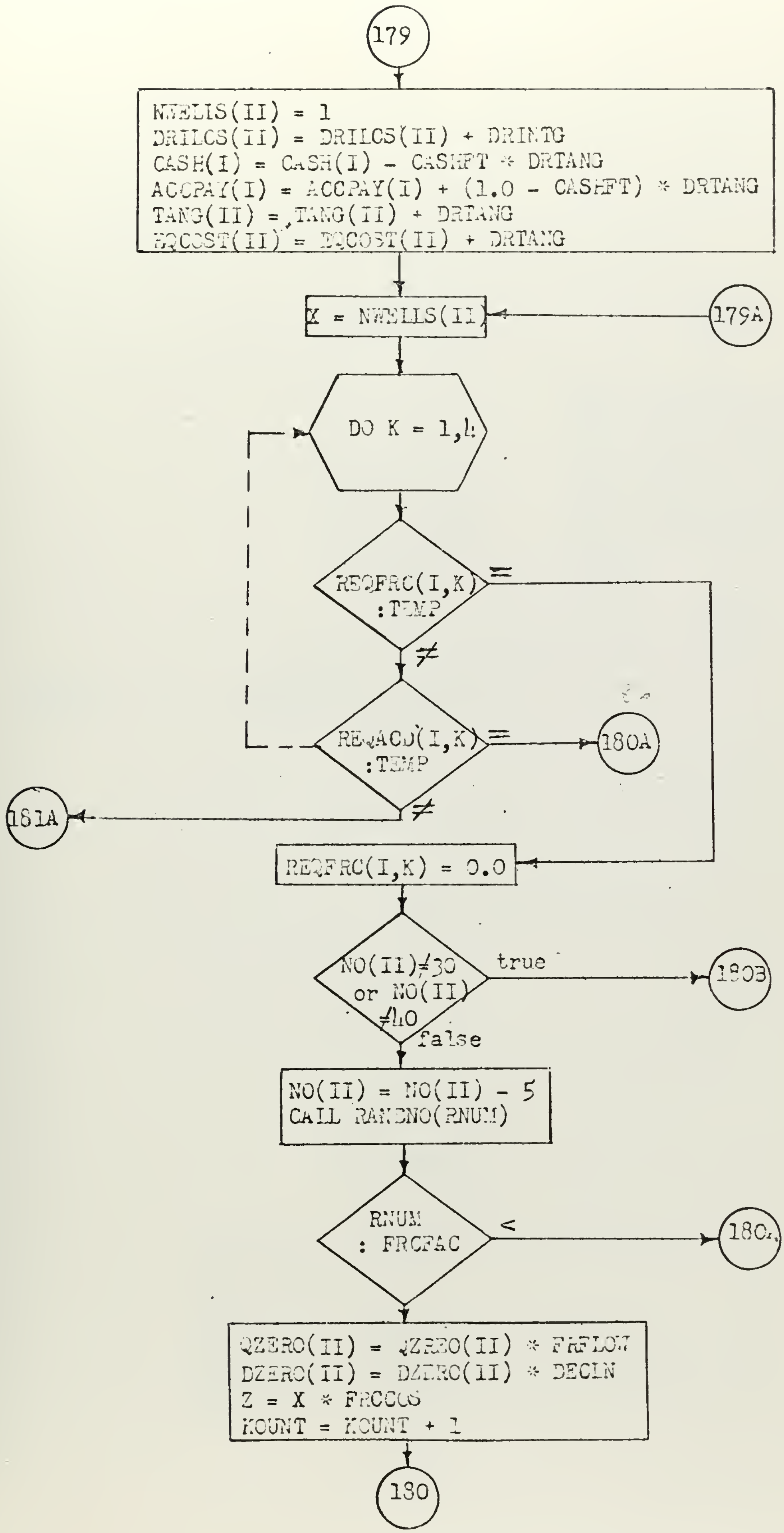

175
JJ : 1
=
≠
WRITE II
XDRILL(I,K,2) : 4.0
>
N = XDRILL(I,K,2)
XDRILL(I,K,2) = 0.0
N = 4
XDRILL(I,K,2) = XDRILL(I,K,2) - 4.0
175A
DO K = 1,N
CALL RANDNO(RNUM)
LESFAC(II) :.001
<
177A
LESFAC(II) -RNUM:0.
≤
RNUM = LESFAC(II)
WELNUM(LASTRM,1) = II
WELNUM(LASTRM,2) = RNUM
LESFAC(II) = LESFAC(II) - RNUM
NWELLS(II) = NWELLS(II) + 1
HOLD2 = QZERO(II) * RNUM
OILFAC = (HOLD2 - HOLD2/EXP(DZERO(II)))/2.0
PI = OILFAC/((PINT(II) - PINT(II)/EXP(DZERO(II) * 1.4))/2.0)
176

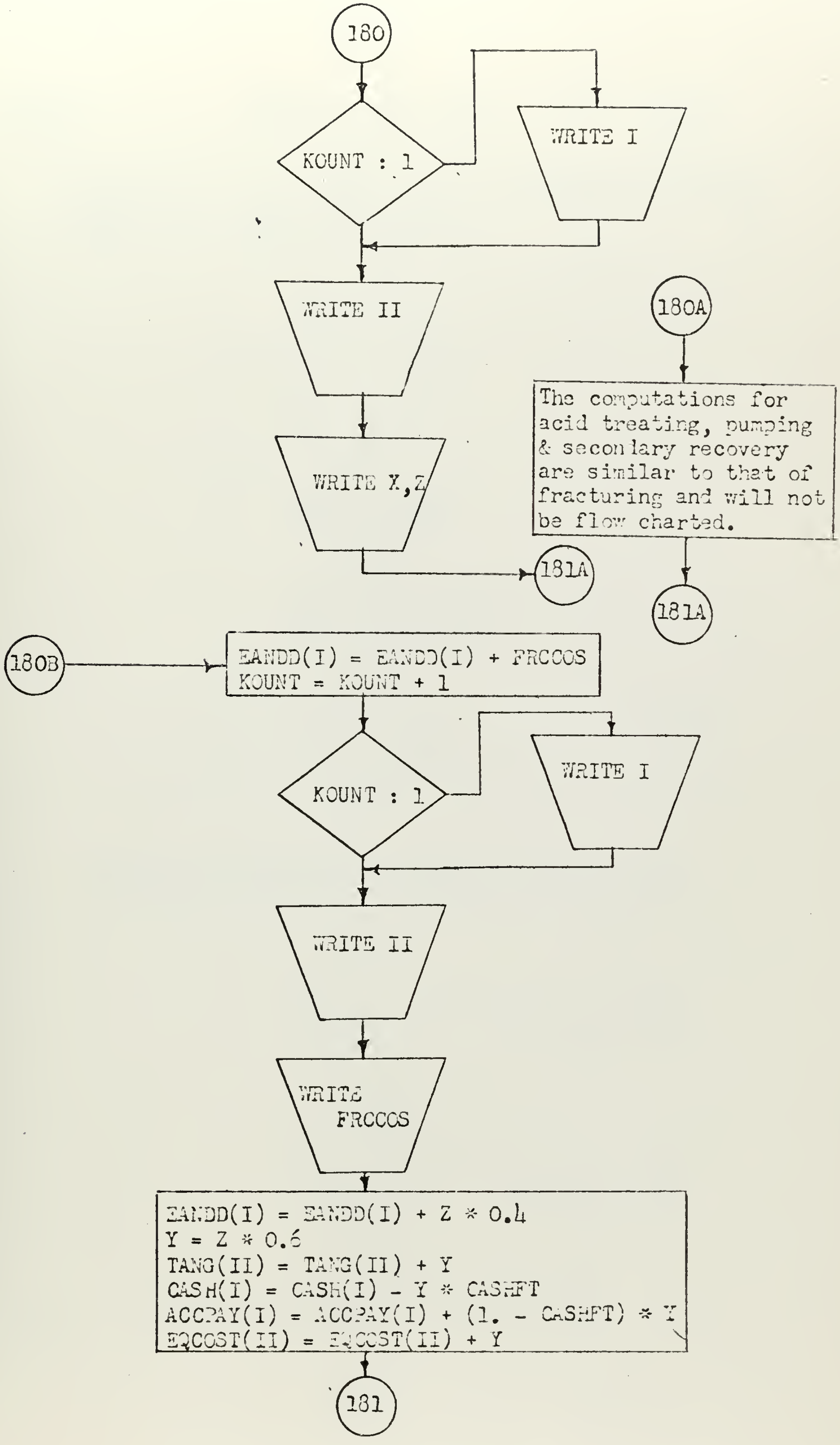

176
WRITE JJ,K, HOLD2,PINT (II),PI
DRILCS(II) = DRILCS(II) + DRINTG
CASH(I) = CASH(I) - CASHFT * DRTANG
ACCPAY(I) = ACCPAY(I) + (1.0 - CASHFT) * DRTANG
TANG(II) = TANG(II) + DRTANG
EQCOST(II) = EQCOST(II) + DRTANG
LASTNM = LASTNM + 1
NO(II):10
<
RANDD(I) = RANDD(I) + FRGCOS
NO(II):25
<
RANDD(I) = RANDD(I) + FMPCOS
175A
179A
KOUNT = KOUNT + 1
176A
KOUNT : 1
=
≠
WRITE I
JJ : 1
=
≠
WRITE II
XDRILL(I,K,2) = XDRILL(I,K,2) -1.0
CALL RANDNO(RNUM)
RNUM : GEOFAC(II)
≤
177B
177

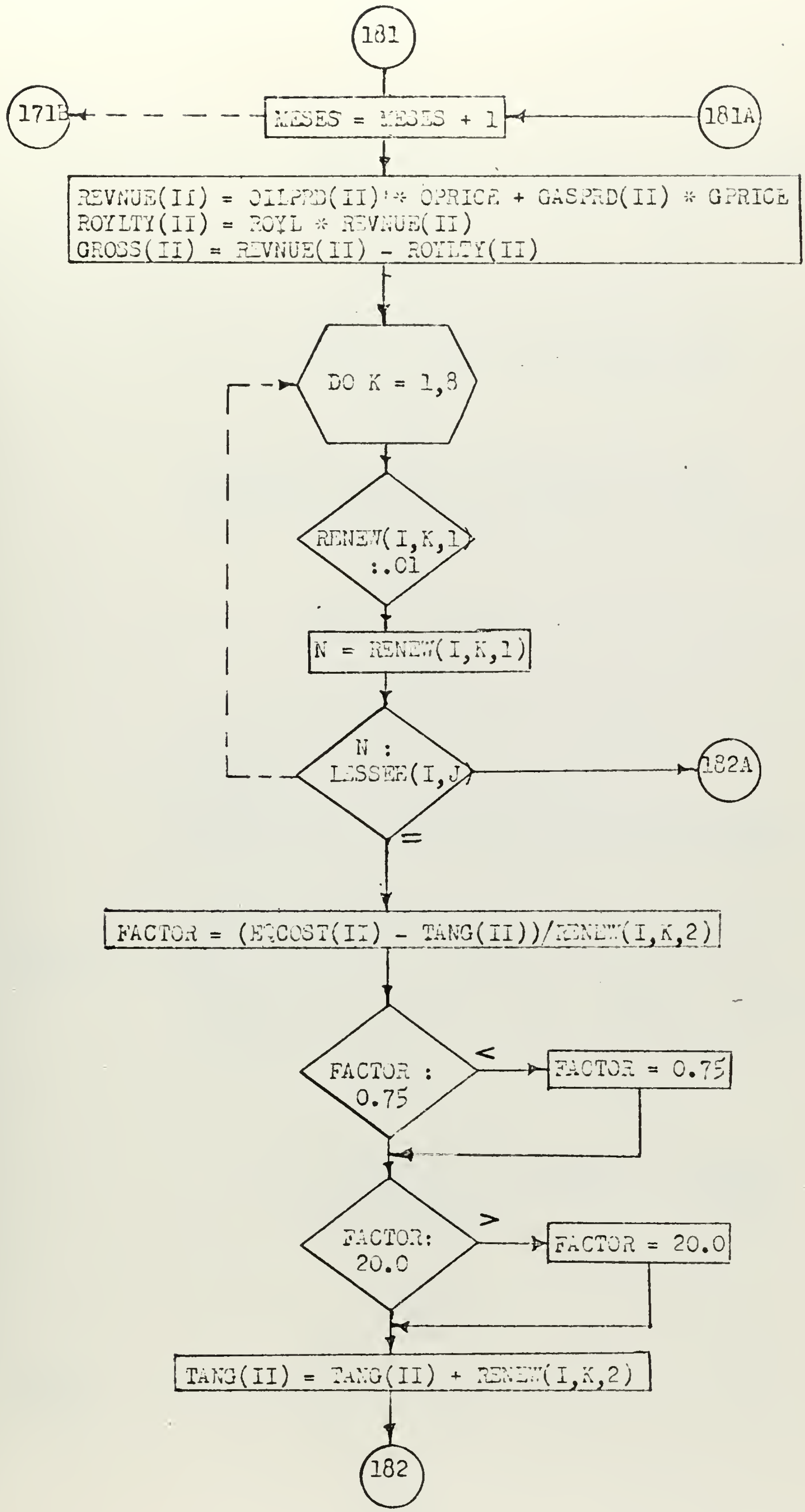


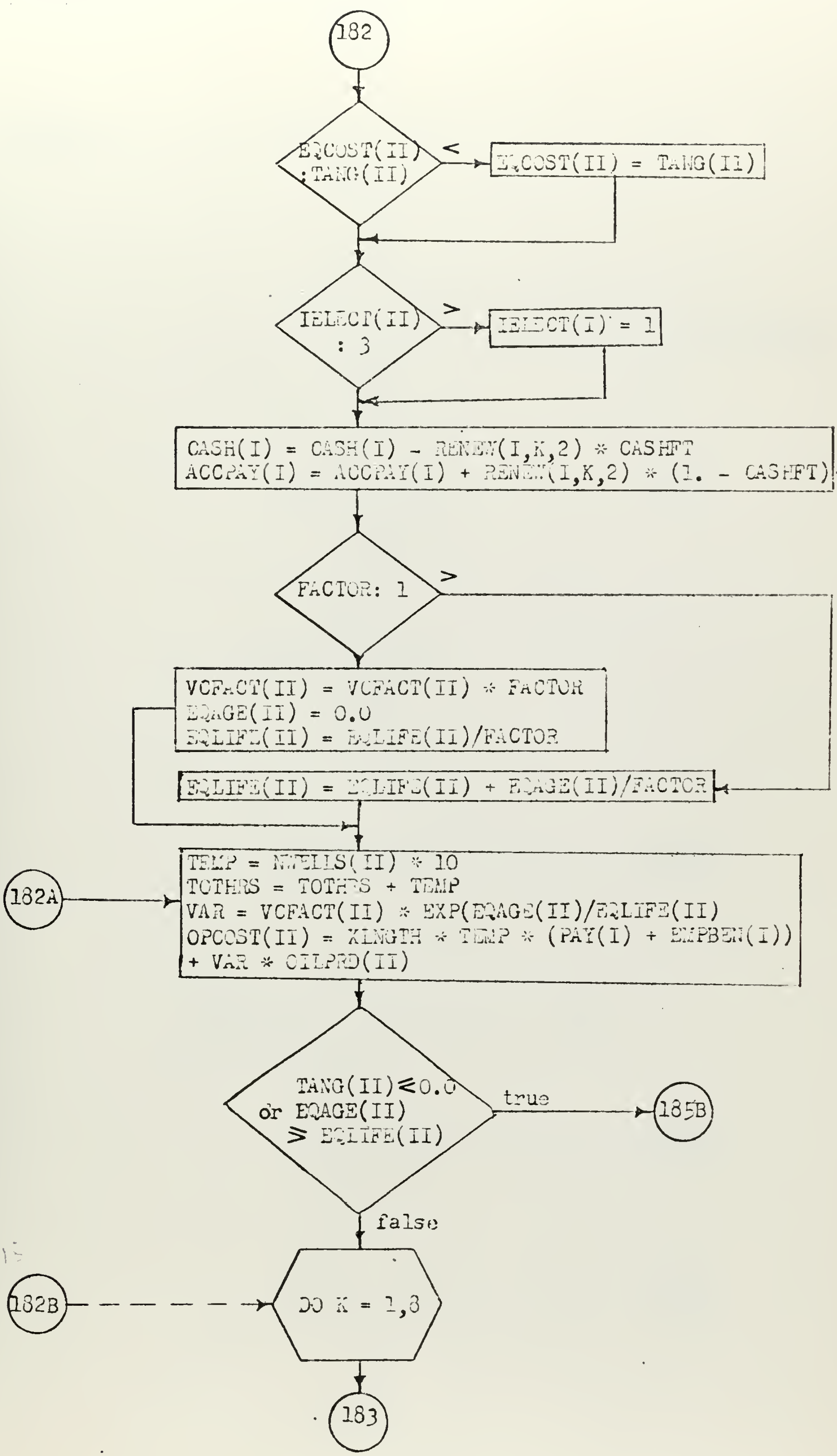
177
177A
GEOFAC(II) = 0.0
HOLD2 = 0.0
NWELLS(II) : 0
K = 1
WRITE JJ,K, DRY,HOLD2
RANDD(I) = RANDD(I) + DRYHCS
XDRILL(I,KK,1) = 0.0
XDRILL(I,KK,2) = 0.0
≤
NWELLS(II) : 0
>
186C
179A
X = 0.0
W = 0.0
CALL RANDNO(RNUM)
177B
DO K = 1,9
W = W + FLOAT(K)
Y = W/45.
RNUM > X & RNUM ≤ Y
false
X = Y
185B
true
CALL RANDNO(RNUM)
178

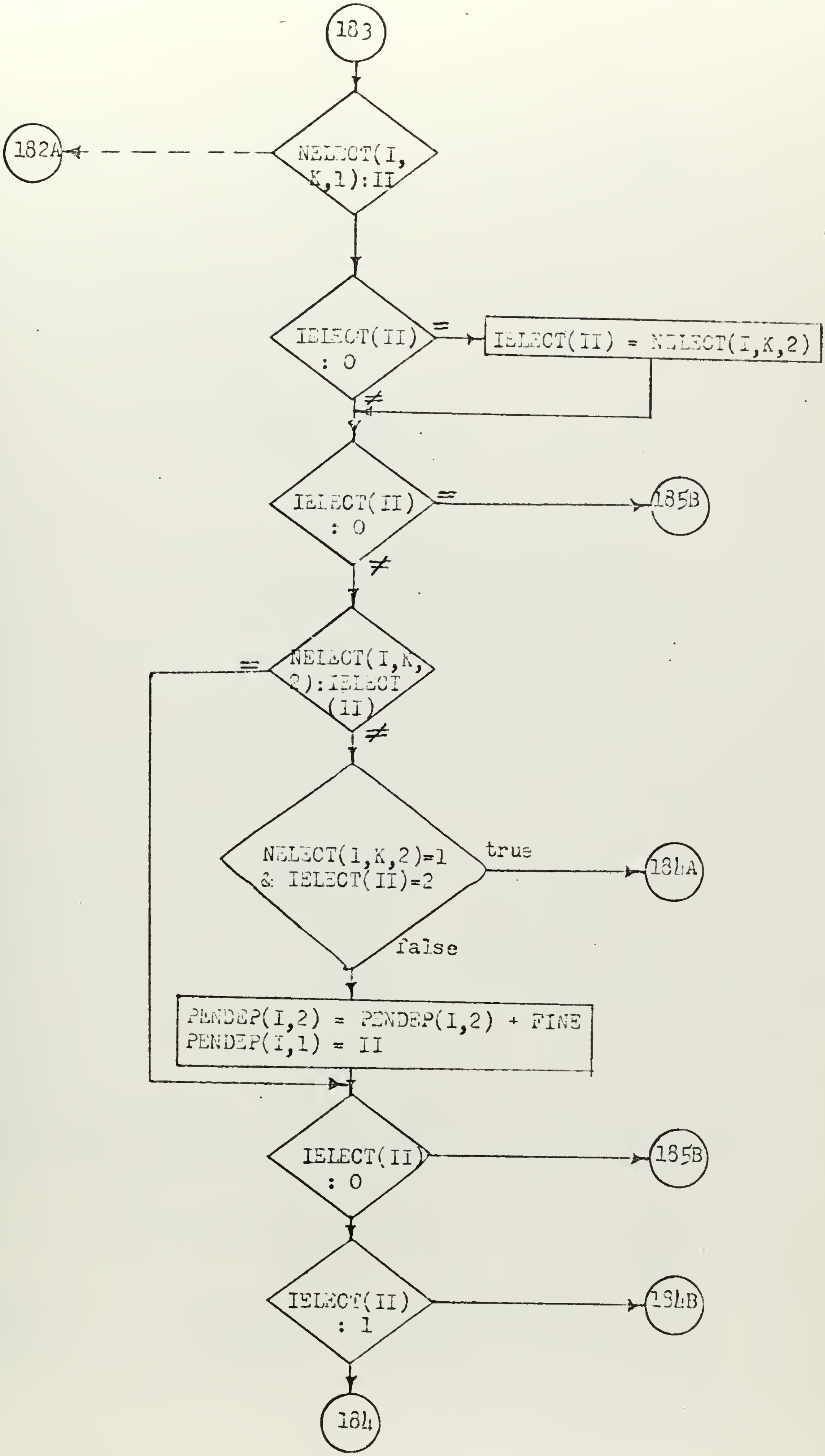

178
GO TO
(663,664,665,
666,667,668,669,
670, 671) K
Since all of these statements are similar only one will be charted.
RESORS(II) = (120. + RNUM * 116.) * 10000.
LESFAC(II) = RESORS(II) * .000006
DZERO(II) = 0.035
QZERO(II) = 1./.000012 * DZERO(II)/.995
PINT(II) = 1000. + RNUM * 4000.
FVF(II) = 1.1 + RNUM * .4
CALL RANDNO(RNUM)
WELNUM(LASTNM,1) = II
WELNUM(LASTNM,2) = RNUM
LASTNM = LASTNM + 1
LESFAC(II) = LESFAC(II) - RNUM
K = 1
HOLD2 = QZERO(II) * RNUM
OILFAC = (HOLD2 - HOLD2/EXP(DZERO(II)))/2.0
PI = OILFAC/((PINT(II) - PINT(II)/EXP(DZERO(II) * 1.4))/2.)
CALL RANDNO(RNUM)
VISCTY(II) = 0.1 + 20. * RNUM
CALL RANDNO(RNUM)
GORINT(II) = 1000. * RNUM
PAYOUT = 7.08 * PI/(VISCTY(II) * FVF(II) * 7.6)
PAYOUT< 5&VISCTY(II) > 2.0
false
true
VISCTY(II) = VISCTY(II) - .1
WRITE JJ,K,
OIL,HOLD2,
PINT(II),PI,
VISCTY(II)
,FVF(II)
179

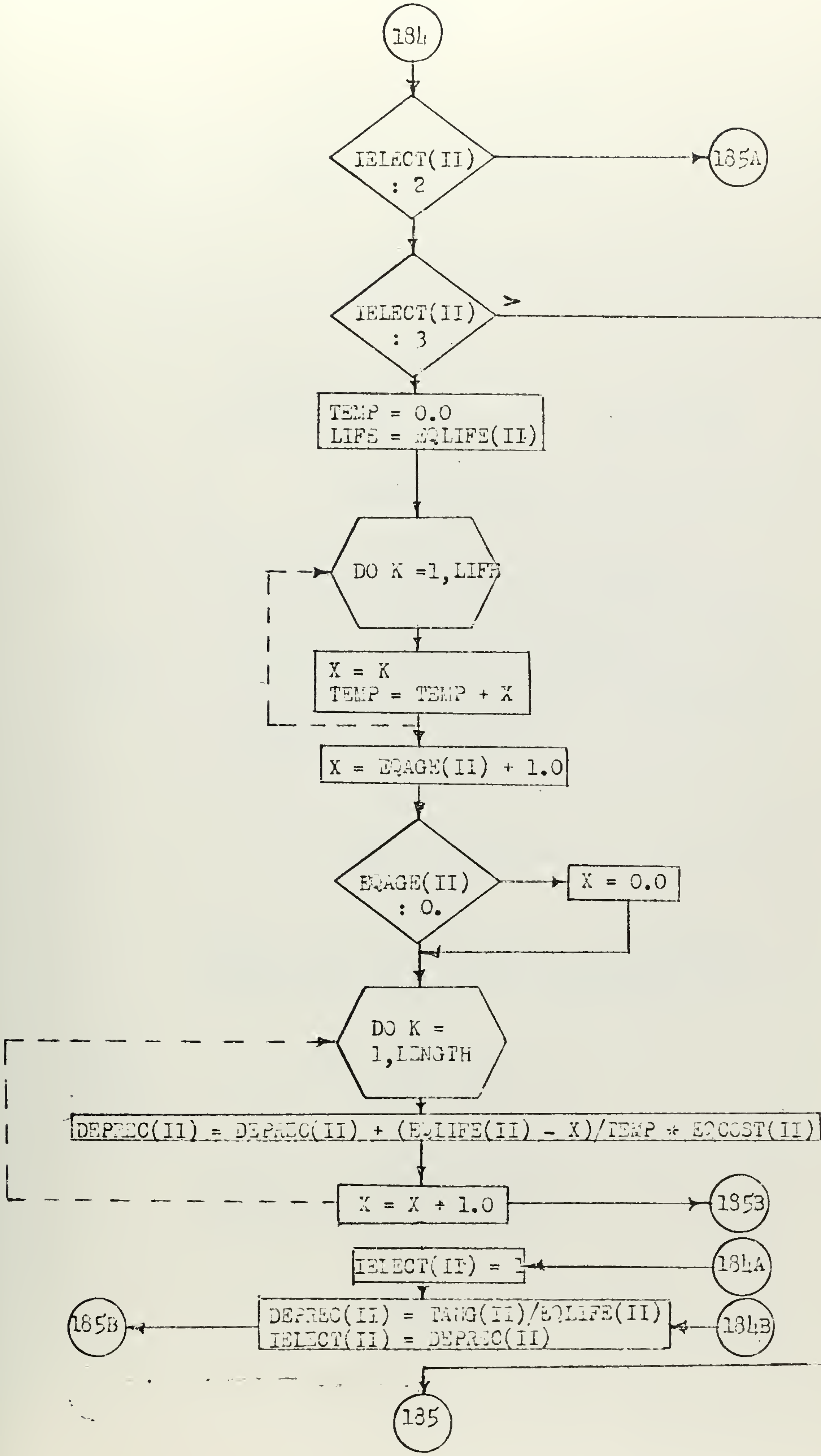

179
NWELLS(II) = 1
DRILCS(II) = DRILCS(II) + DRINTG
CASH(I) = CASH(I) - CASHFT * DRTANG
ACCPAY(I) = ACCPAY(I) + (1.0 - CASHFT) * DRTANG
TANG(II) = TANG(II) + DRTANG
EQCOST(II) = EQCOST(II) + DRTANG
X = NWELLS(II)
179A
DO K = 1,4
REQFRC(I,K) :TEMP
=
≠
REQACD(I,K) :TEMP
=
180A
≠
181A
REQFRC(I,K) = 0.0
NO(II)≠30 or NO(II) ≠40
true
180B
false
NO(II) = NO(II) - 5
CALL RANDNO(RNUM)
RNUM : FRCFAC
<
180C
QZERO(II) = QZERO(II) * FRFLOW
DZERO(II) = DZERO(II) * DECIN
Z = X * FRCCOS
KOUNT = KOUNT + 1
180

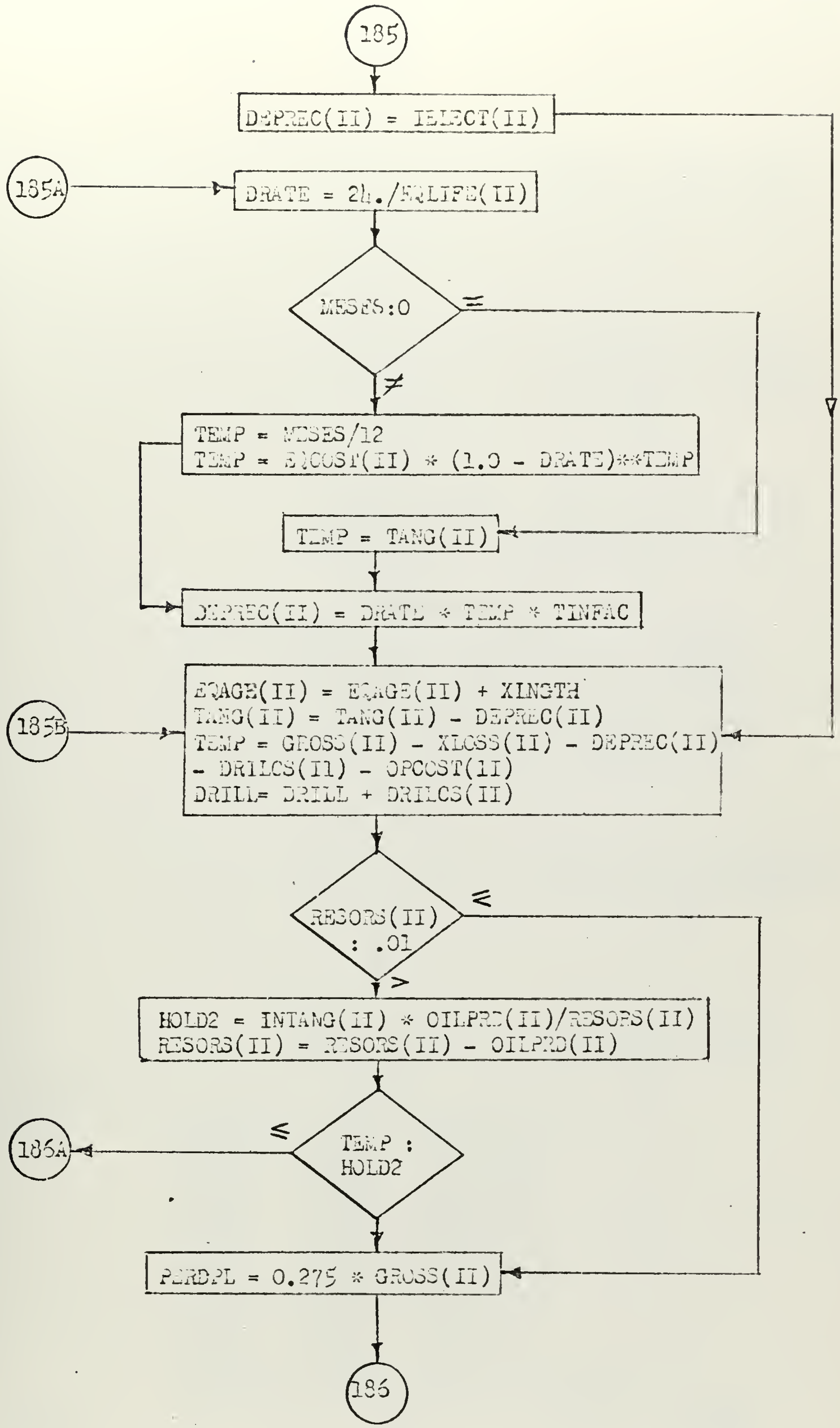

180
KOUNT : 1
WRITE I
WRITE II
WRITE X,Z
181A
180A
The computations for acid treating, pumping & seconlary recovery are similar to that of fracturing and will not be flow charted.
181A
180B
EANDD(I) = EANDD(I) + FRCCOS
KOUNT = KOUNT + 1
KOUNT : 1
WRITE I
WRITE II
WRITE FRCCOS
EANDD(I) = EANDD(I) + Z * 0.4
Y = Z * 0.6
TANG(II) = TANG(II) + Y
CASH(I) = CASH(I) - Y * CASHFT
ACCPAY(I) = ACCPAY(I) + (1. - CASHFT) * Y
EQCOST(II) = EQCOST(II) + Y
181


181
171B
MESES = MESES + 1
181A
REVNUE(II) = OILPRD(II) * OPRICE + GASPRD(II) * GPRICE
ROYLTY(II) = ROYL * REVNUE(II)
GROSS(II) = REVNUE(II) - ROYLTY(II)
DO K = 1,8
RENEW(I,K,1) :.01
N = RENEW(I,K,1)
N : LESSER(I,J)
182A
=
FACTOR = (EQCOST(II) - TANG(II))/RENEW(I,K,2)
FACTOR : 0.75
<
FACTOR = 0.75
FACTOR: 20.0
>
FACTOR = 20.0
TANG(II) = TANG(II) + RENEW(I,K,2)
182

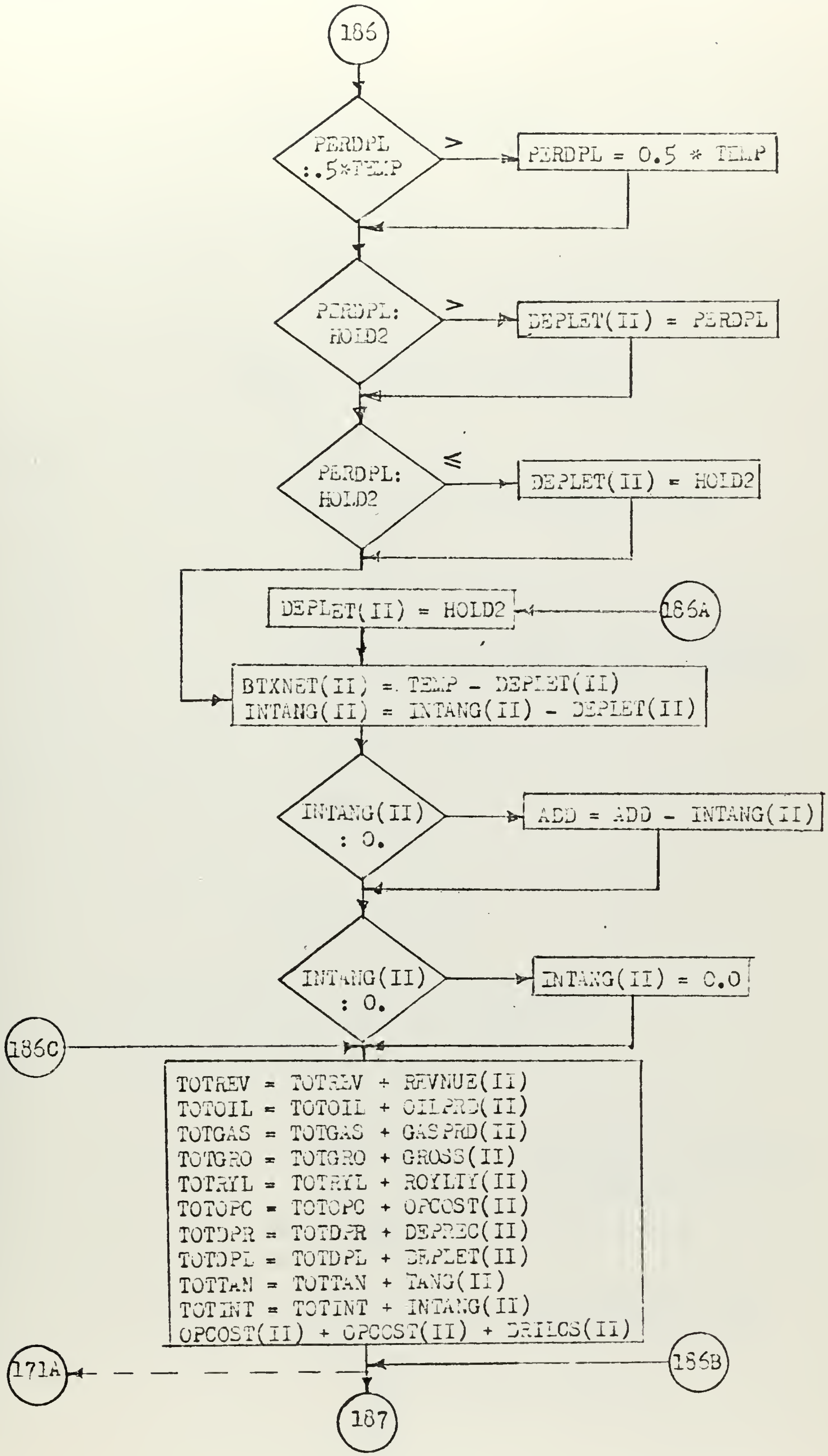

182
EQCOST(II) : TANG(II)
<
EQCOST(II) = TANG(II)
IELECT(II) : 3
>
IELECT(I) = 1
CASH(I) = CASH(I) - RENEW(I,K,2) * CASHFT
ACCPAY(I) = ACCPAY(I) + RENEW(I,K,2) * (1. - CASHFT)
FACTOR: 1
>
VCFACT(II) = VCFACT(II) * FACTOR
EQAGE(II) = 0.0
EQLIFE(II) = EQLIFE(II)/FACTOR
EQLIFE(II) = EQLIFE(II) + EQAGE(II)/FACTOR
182A
TEMP = NWELLS(II) * 10
TOTHRS = TOTHRS + TEMP
VAR = VCFACT(II) * EXP(EQAGE(II)/EQLIFE(II)
OPCOST(II) = XLNGTH * TEMP * (PAY(I) + EMPBEN(I))
+ VAR * OILPRD(II)
TANG(II) ≤ 0.0 or EQAGE(II) ≥ EQLIFE(II)
true
185B
false
182B
DO K = 1,8
183

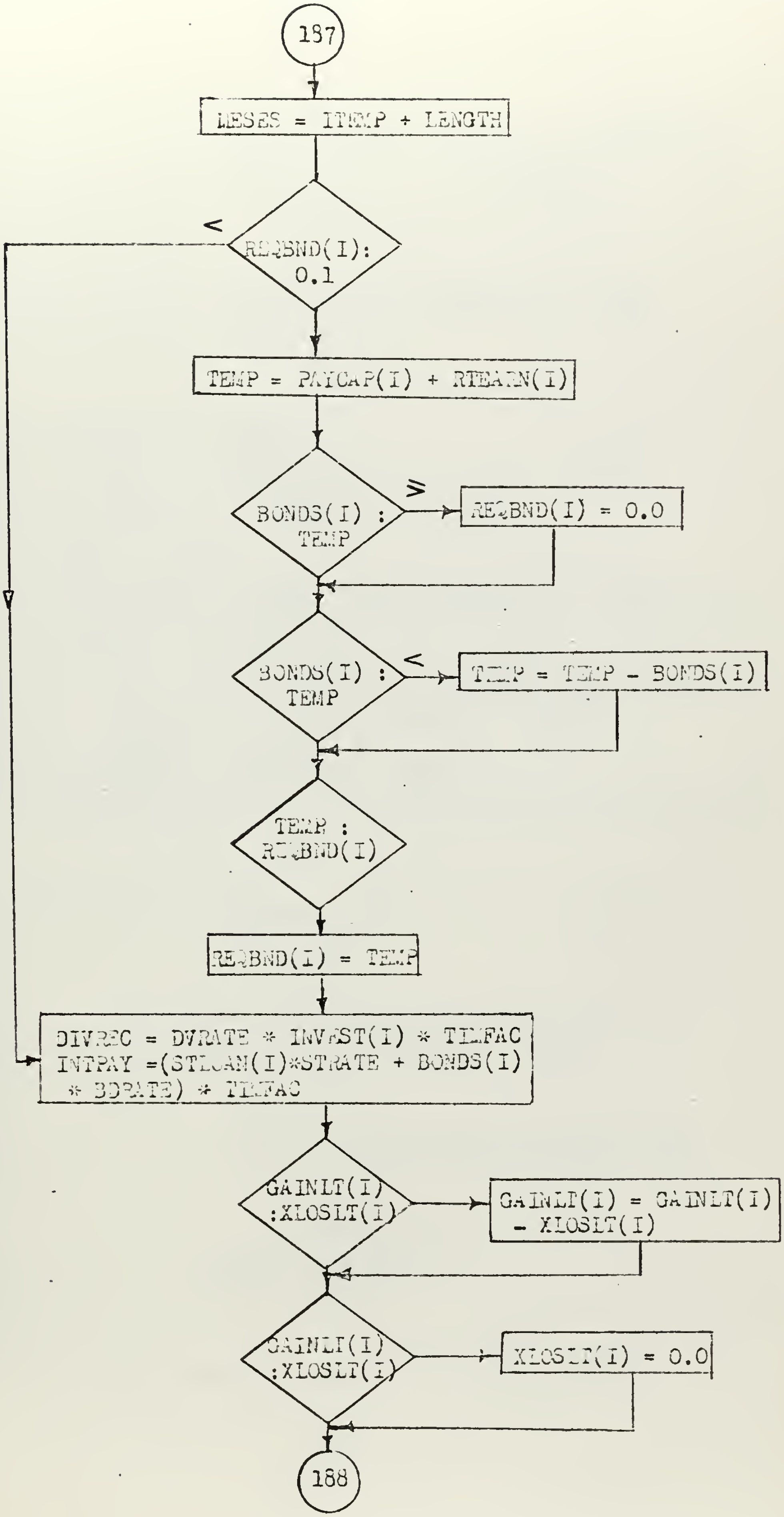

183
182A
NELECT(I,K,1):II
IELECT(II) : 0
=
IELECT(II) = NELECT(I,K,2)
≠
IELECT(II) : 0
=
185B
≠
NELECT(I,K,2):IELECT(II)
=
≠
NELECT(1,K,2)=1 & IELECT(II)=2
true
184A
false
PENDEP(I,2) = PENDEP(I,2) + FINE
PENDEP(I,1) = II
IELECT(II) : 0
185B
IELECT(II) : 1
184B
184

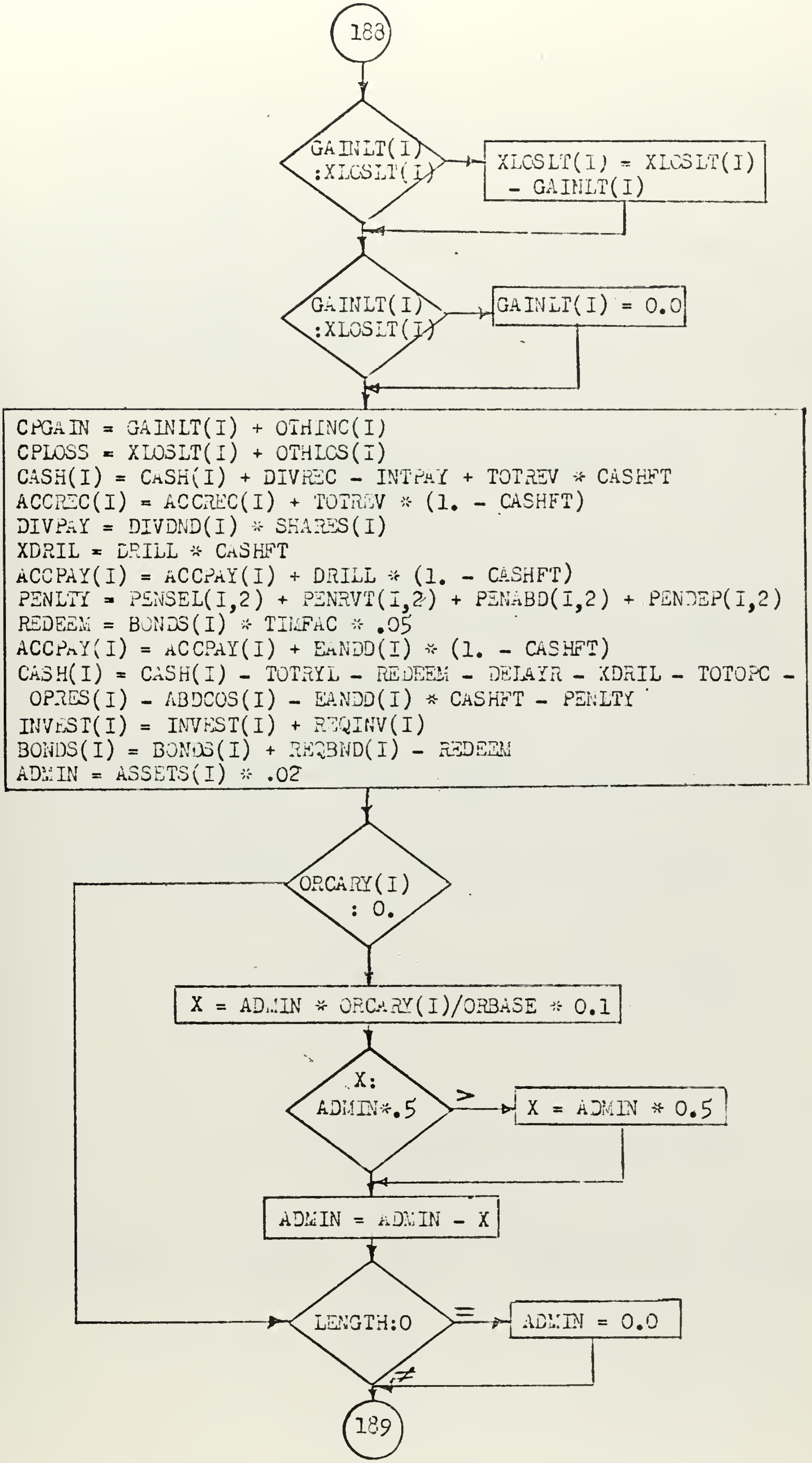

184
IELECT(II) : 2
185A
IELECT(II) : 3
TEMP = 0.0
LIFE = EQLIFE(II)
DO K =1,LIFE
X = K
TEMP = TEMP + X
X = EQAGE(II) + 1.0
EQAGE(II) : 0.
X = 0.0
DO K = 1,LENGTH
DEPREC(II) = DEPREC(II) + (EQLIFE(II) - X)/TEMP * EQCOST(II)
X = X + 1.0
185B
IELECT(II) = 1
184A
DEPREC(II) = TANG(II)/EQLIFE(II)
IELECT(II) = DEPREC(II)
185B
184B
185

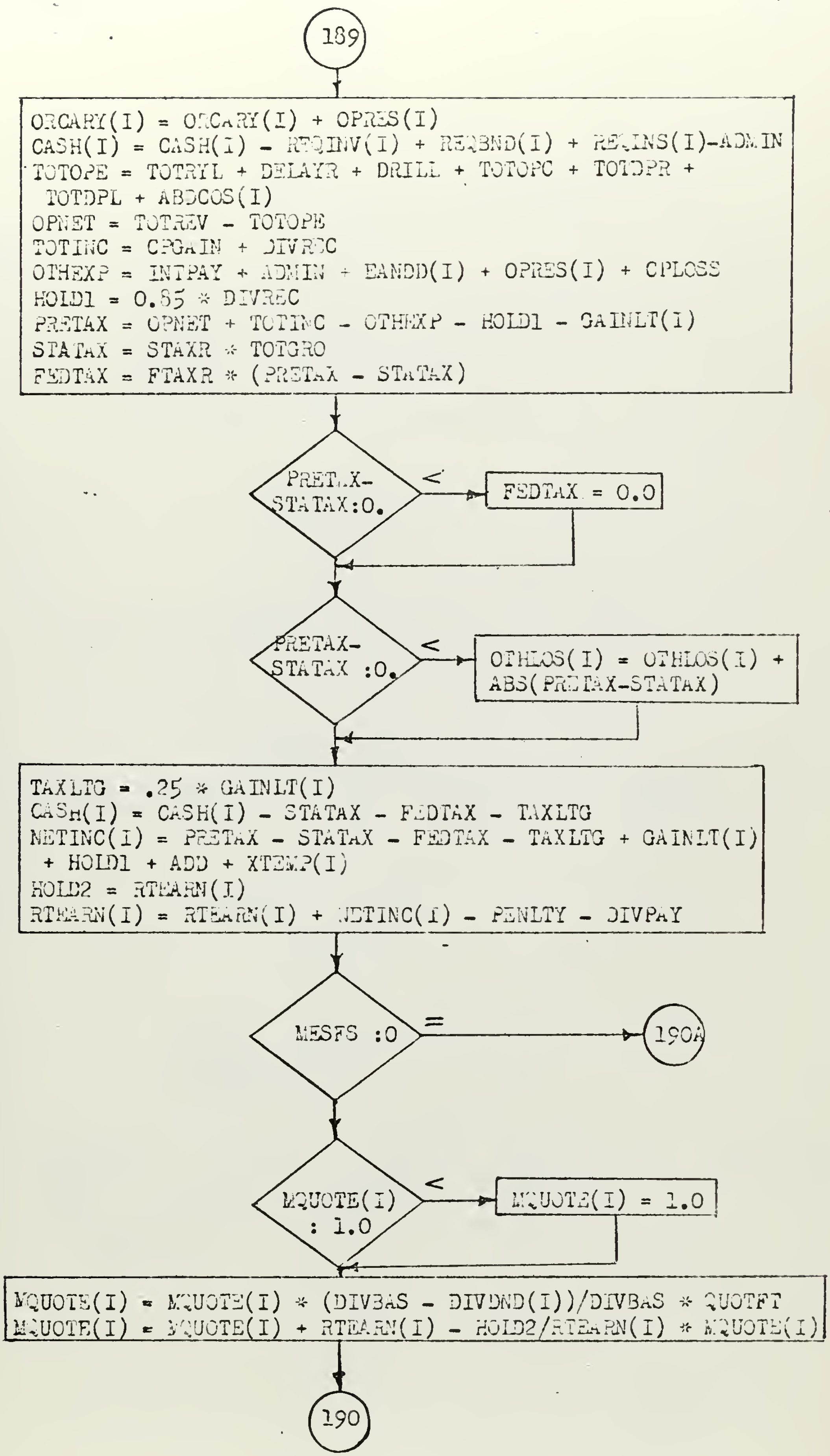


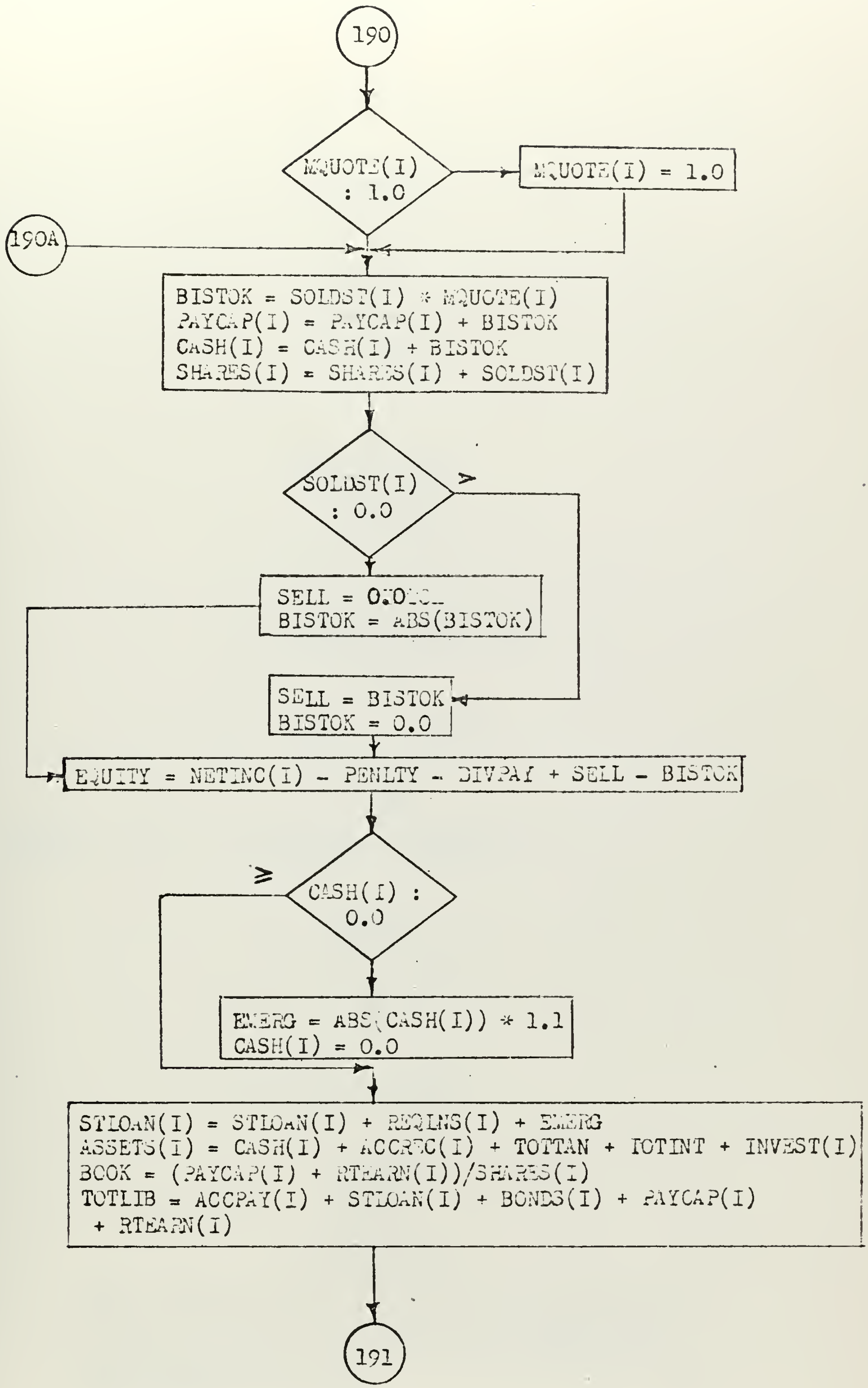
185
DEPREC(II) = IELECT(II)
185A
DRATE = 24./EQLIFE(II)
MESES:0
=
≠
TEMP = MESES/12
TEMP = EQCOST(II) * (1.0 - DRATE)**TEMP
TEMP = TANG(II)
DEPREC(II) = DRATE * TEMP * TINFAC
185B
EQAGE(II) = EQAGE(II) + XINGTH
TANG(II) = TANG(II) - DEPREC(II)
TEMP = GROSS(II) - XLOSS(II) - DEPREC(II)
- DRILCS(II) - OPCOST(II)
DRILL= DRILL + DRILCS(II)
RESORS(II) : .01
≤
>
HOLD2 = INTANG(II) * OILPRD(II)/RESORS(II)
RESORS(II) = RESORS(II) - OILPRD(II)
TEMP : HOLD2
≤
186A
PERDPL = 0.275 * GROSS(II)
186


186
PERDPL
:.5*TEMP
>
PERDPL = 0.5 * TEMP
PERDPL:
HOLD2
>
DEPLET(II) = PERDPL
PERDPL:
HOLD2
≤
DEPLET(II) = HOLD2
DEPLET(II) = HOLD2
186A
BTXNET(II) = TEMP - DEPLET(II)
INTANG(II) = INTANG(II) - DEPLET(II)
INTANG(II)
: 0.
ADD = ADD - INTANG(II)
INTANG(II)
: 0.
INTANG(II) = 0.0
186C
TOTREV = TOTREV + REVNUE(II)
TOTOIL = TOTOIL + OILPRD(II)
TOTGAS = TOTGAS + GASPRD(II)
TOTGRO = TOTGRO + GROSS(II)
TOTRYL = TOTRYL + ROYLTY(II)
TOTOPC = TOTOPC + OPCOST(II)
TOTDPR = TOTDPR + DEPREC(II)
TOTDPL = TOTDPL + DEPLET(II)
TOTTAN = TOTTAN + TANG(II)
TOTINT = TOTINT + INTANG(II)
OPCOST(II) + OPCOST(II) + DRILCS(II)
171A
186B
187

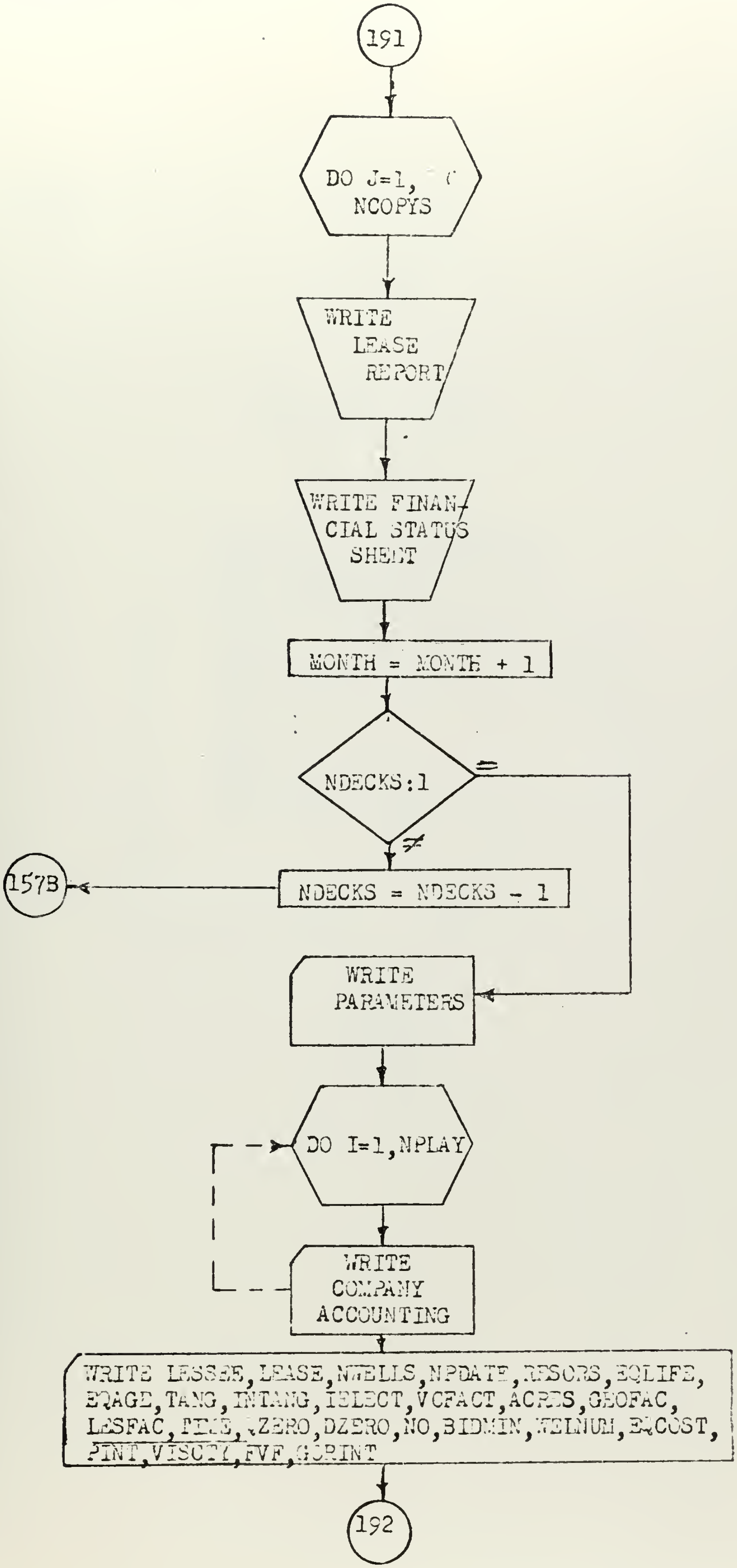

187
LESES = ITEMP + LENGTH
<
REQBND(I): 0.1
TEMP = PAYCAP(I) + RTEARN(I)
BONDS(I) : TEMP
≥
REQBND(I) = 0.0
BONDS(I) : TEMP
<
TEMP = TEMP - BONDS(I)
TEMP : REQBND(I)
REQBND(I) = TEMP
DIVREC = DVRATE * INVEST(I) * TIMFAC
INTPAY =(STLOAN(I)*STRATE + BONDS(I) * BDRATE) * TIMFAC
GAINLT(I) :XLOSLT(I)
GAINLT(I) = GAINLT(I) - XLOSLT(I)
GAINLT(I) :XLOSLT(I)
XLOSLT(I) = 0.0
188

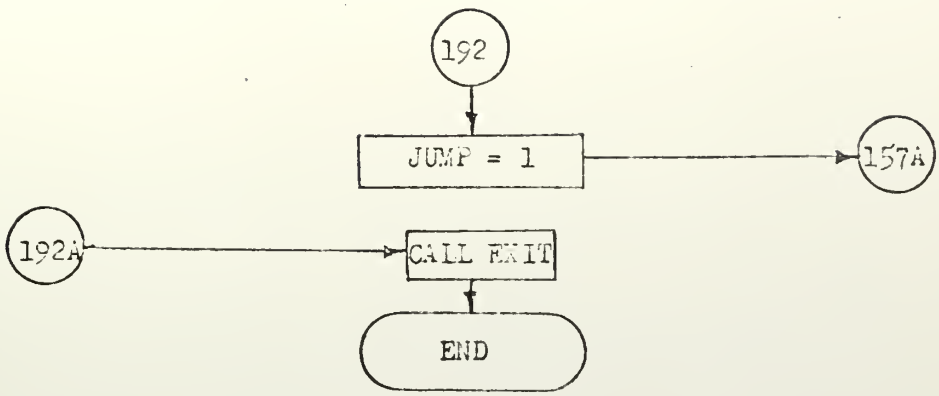

188
GAINLT(I)
:XLOSLT(I)
XLOSLT(I) = XLOSLT(I)
- GAINLT(I)
GAINLT(I)
:XLOSLT(I)
GAINLT(I) = 0.0
CPGAIN = GAINLT(I) + OTHINC(I)
CPLOSS = XLOSLT(I) + OTHLOS(I)
CASH(I) = CASH(I) + DIVREC - INTPAY + TOTREV * CASHFT
ACCREC(I) = ACCREC(I) + TOTREV * (1. - CASHFT)
DIVPAY = DIVDND(I) * SHARES(I)
XDRIL = DRILL * CASHFT
ACCPAY(I) = ACCPAY(I) + DRILL * (1. - CASHFT)
PENLTY = PENSEL(I,2) + PENRVT(I,2) + PENABD(I,2) + PENDEP(I,2)
REDEEM = BONDS(I) * TIMFAC * .05
ACCPAY(I) = ACCPAY(I) + EANDD(I) * (1. - CASHFT)
CASH(I) = CASH(I) - TOTRYL - REDEEM - DELAYR - XDRIL - TOTOPC -
OPRES(I) - ABDCOS(I) - EANDD(I) * CASHFT - PENLTY
INVEST(I) = INVEST(I) + REQINV(I)
BONDS(I) = BONDS(I) + REQBND(I) - REDEEM
ADMIN = ASSETS(I) * .02
ORCARY(I)
: 0.
X = ADMIN * ORCARY(I)/ORBASE * 0.1
X:
ADMIN*.5
>
X = ADMIN * 0.5
ADMIN = ADMIN - X
LENGTH:0
=
ADMIN = 0.0
≠
189


189
ORCARY(I) = ORCARY(I) + OPRES(I)
CASH(I) = CASH(I) - REQINV(I) + REQBND(I) + REQINS(I)-ADMIN
TOTOPE = TOTRYL + DELAYR + DRILL + TOTOPC + TOTDPR +
TOTDPL + ABDCOS(I)
OPNET = TOTREV - TOTOPE
TOTINC = CPGAIN + DIVREC
OTHEXP = INTPAY + ADMIN + EANDD(I) + OPRES(I) + CPLOSS
HOLD1 = 0.85 * DIVREC
PRETAX = OPNET + TOTINC - OTHEXP - HOLD1 - GAINLT(I)
STATAX = STAXR * TOTGRO
FEDTAX = FTAXR * (PRETAX - STATAX)
PRETAX-STATAX:0.
<
FEDTAX = 0.0
PRETAX-STATAX :0.
<
OTHLOS(I) = OTHLOS(I) + ABS(PRETAX-STATAX)
TAXLTG = .25 * GAINLT(I)
CASH(I) = CASH(I) - STATAX - FEDTAX - TAXLTG
NETINC(I) = PRETAX - STATAX - FEDTAX - TAXLTG + GAINLT(I)
+ HOLD1 + ADD + XTEMP(I)
HOLD2 = RTEARN(I)
RTEARN(I) = RTEARN(I) + NETINC(I) - PENLTY - DIVPAY
MESFS :0
=
190A
MQUOTE(I) : 1.0
<
MQUOTE(I) = 1.0
MQUOTE(I) = MQUOTE(I) * (DIVBAS - DIVDND(I))/DIVBAS * QUOTFT
MQUOTE(I) = MQUOTE(I) + RTEARN(I) - HOLD2/RTEARN(I) * MQUOTE(I)
190

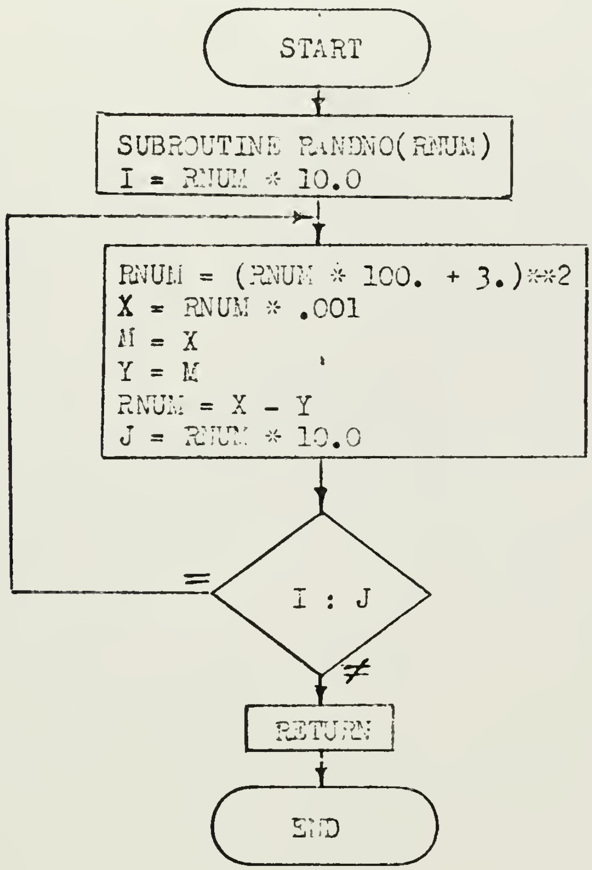


190
MQUOTE(I) : 1.0
MQUOTE(I) = 1.0
190A
BISTOK = SOLDST(I) * MQUOTE(I)
PAYCAP(I) = PAYCAP(I) + BISTOK
CASH(I) = CASH(I) + BISTOK
SHARES(I) = SHARES(I) + SOLDST(I)
SOLDST(I) : 0.0
>
SELL = 0.0
BISTOK = ABS(BISTOK)
SELL = BISTOK
BISTOK = 0.0
EQUITY = NETINC(I) - PENLTY - DIVPAY + SELL - BISTOK
CASH(I) : 0.0
≥
EMERG = ABS(CASH(I)) * 1.1
CASH(I) = 0.0
STLOAN(I) = STLOAN(I) + REQLNS(I) + EMERG
ASSETS(I) = CASH(I) + ACCREC(I) + TOTTAN + TOTINT + INVEST(I)
BOOK = (PAYCAP(I) + RTEARN(I))/SHARES(I)
TOTLIB = ACCPAY(I) + STLOAN(I) + BONDS(I) + PAYCAP(I)
+ RTEARN(I)
191


191
DO J=1, NCOPYS
WRITE LEASE REPORT
WRITE FINANCIAL STATUS SHEET
MONTH = MONTH + 1
NDECKS:1
=
≠
NDECKS = NDECKS - 1
157B
WRITE PARAMETERS
DO I=1,NPLAY
WRITE COMPANY ACCOUNTING
WRITE LESSEE,LEASE,NWELLS,NPDATE,RESORS,EQLIFE, EQAGE,TANG,INTANG,IELECT,VCFACT,ACRES,GEOFAC, LESFAC,TIME,QZERO,DZERO,NO,BIDMIN,WELNUM,EQCOST, PINT,VISCTY,FVF,GORINT
192




SUBROUTINE RANDNO



# APPENDIX B

Computer Program

```
      ****  PAYDIRT  --  AN ENGINEERING-MANAGEMENT SIMULATION  ****
      ****  PROGRAMED IN FORTRAN IV COMPUTOR LANGUAGE  ****

      REAL INTANG, INVEST, INTREC, INIPAY, NETINC, LESFAC, MQUOTE
      DIMENSION BID(5,8,2), ACRES(56), IDENT(5), LEASE(56), LESSEE(5,20)
     1,PAYCAP(5), PENSEL(5,2), RVFRSN(5,4), ABAND(5,4), PENRVT(5,2),
     2 PENABD(5,2), NWELLS(56),   ABDCOS(5),   OILPRD(56), GASPRD(56),
     3GORINT(56), NETINC(5), OTHINC(5), SOLDST(5), GAINLT(5), XLOSLT(5),
     4 OPCOST(56), REVNUE(56), ROYLTY(56), GROSS(56), INTANG(56),
     5TANG(56), BTXNET(56), DIVDND(5), XLOSS(56), DEPLET(56), ACCREC(5),
     6DEPREC(56), DRILCS(56), EQAGE(56), IELECT(56), RESORS(56),
     7VCFACT(56), DZERO(56), NELECT(5,8,2), RENEW(5,8,2), PENDEP(5,2),
     8ACCPAY(5), INVEST(5), CASH(5), STLOAN(5), EMPBEN(5), BONDS(5),
     9SHARES(5), RTEARN(5), MQUOTE(5), REQLNS(5), REQPAY(5), REQINV(5)
      DIMENSION OTHLOS(5), REQBND(5), EANDD(5), OPRES(5), NPDATE(56),
     1 FRINGE(5), PAY(5), ORCARY(5), QZERO(56), EQLIFE(56), EQCOST(56),
     2 LESFAC(56), TIME(56), GEOFAC(56), WELNUM(1000,2), NO(56),
     3 REQFRC(5,4), REQACD(5,4), BIDMIN(56), XDRILL(5,8,2), ASSETS(5),
     4 PINT(56), VISCTY(56), FVF(56), REQPMP(5,4), XTEMP(5), REQSEC(5,4)
C
    1 FORMAT (1H1)
    2 FORMAT (1H0)
    3 FORMAT (1H0/)
    4 FORMAT (1H0//)
    5 FORMAT (1H )
    8 FORMAT (2A6,I4)
    9 FORMAT (20F4.0)
   10 FORMAT (1X,20F4.0)
   11 FORMAT (8F10.2)
   12 FORMAT (8I10)
   13 FORMAT (7F10.0,F10.2)
   14 FORMAT (10I8)
   15 FORMAT (1X,8F10.0)
   16 FORMAT (16F5.2)
   17 FORMAT (1X,16F5.2)
   18 FORMAT (20I4)
   19 FORMAT (1X,20I4)
   21 FORMAT (1X,8F10.2)
   22 FORMAT (1X,8I10)
   24 FORMAT (1X,10I8)
   25 FORMAT (8F10.0)
   26 FORMAT (1X,7F10.0,F10.2)
   27 FORMAT (16F5.0)
   28 FORMAT (1X,16F5.0)
   29 FORMAT (8F10.6)
   30 FORMAT (1X,8F10.6)
C
      JUMP = 0
      READ (5,8) DRY, OIL, NDECKS
      READ (5,12) MONTH,NYEAR,LENGTH,MESES,NCOPYS,NPLAY,MAXOWN,LASTNM
      READ (5,11) FINE,OPRICE,GPRICE,ABDNFT,FTAXR,STAXR,STKFAC,VARCOS
      READ (5,11) BDRATE,BENFIT,BENBAS,RLABOR,PAYBAS,DIVBAS,ORBASE,
     1 STRATE
      READ (5,11) RNUM,ROYL,TERMSR,TERMSP,DVRATE,DRTANG,DRINTG,FRCCOS
      READ (5,11) OILALW,GASALW,DRYHCS,CASHFT,QUOTFT,FRCFAC,ACDFAC,
     1 EQCSFT
      READ (5,11) PMPCOS,ACDCOS,SECCOS,FRFLOW,ACFLOW,PMFLOW,SRFLOW,DECLN
      XLNGTH = LENGTH
      TIMFAC = XLNGTH/12.
      NDEAL = 0
```

```
      DO 110 I = 1,NPLAY
      READ (5,11) CASH(I),ASSETS(I),ACCREC(I),ACCPAY(I),INVEST(I),
     1 STLOAN(I),BONDS(I),MQUOTE(I)
      READ (5,11) PAYCAP(I),RTEARN(I),SHARES(I),ORCARY(I),OTHLOS(I),
     1 PAY(I), NETINC(I), EMPBEN(I)
      OTHINC(I) = 0.0
      XLOSLT(I) = 0.0
      GAINLT(I) = 0.0
      IDENT(I) = 0
      PENSEL(I,2) = 0.0
      PENRVT (I,2) = 0.0
      PENDEP(I,2) = 0.0
      ABDCOS(I) = 0.0
  110 PENABD (I,2) = 0.0
      READ (5,18)((LESSEE(I,K), K=1,20) , I=1,NPLAY)
      READ (5,18) LEASE
      READ (5,18) NWELLS
      READ (5,18) NPDATE
      READ (5,11) RESORS
      READ (5,27) EQLIFE
      READ (5,27) EQAGE
      READ (5,11) TANG
      READ (5,11) INTANG
      READ (5,18) IELECT
      READ (5,16) VCFACT
      READ (5,11) ACRES
      READ (5,16) GEOFAC
      READ (5,11) LESFAC
      READ (5,11) TIME
      READ (5,11) QZERO
      READ (5,29) DZERO
      READ (5,18) NO
      READ (5,25) BIDMIN
      READ (5,9) (WELNUM(I,1), I=1,1000)
      READ (5,16) (WELNUM(I,2), I=1,1000)
      READ (5,25) EQCOST
      READ (5,25) PINT
      READ (5,11) VISCTY
      READ (5,16) FVF
      READ (5,25) GORINT
  101 WRITE (6,1)
      WRITE(6,8) DRY, OIL, NDECKS
      WRITE(6,22) MONTH,NYEAR,LENGTH,MESES,NCOPYS,NPLAY,MAXOWN,LASTNM
      WRITE(6,21) FINE,OPRICE,GPRICE,ABDNFT,FTAXR,STAXR,STKFAC,VARCOS
      WRITE(6,21) RATEBD,BENFIT,BENBAS,RLABOR,PAYBAS,DIVBAS,ORBASE,
     1 STRATE
      WRITE(6,21) RNUM,ROYL,TERMSR,TERMSP,DVRATE,DRTANG,DRINTG,FRCCOS
      WRITE(6,21) OILALW,GASALW,DRYHCS,CASHFT,QUOTFT,FRCFAC,ACDFAC,
     1 EQCSFT
      WRITE(6,21) PMPCOS,ACDCOS,SECCOS,FRFLOW,ACFLOW,PMFLOW,SRFLOW,DECLN
      DO 102 I = 1,NPLAY
      WRITE(6,26) CASH(I),ASSETS(I),ACCREC(I),ACCPAY(I),INVEST(I),
     1 STLOAN(I),BONDS(I),MQUOTE(I)
  102 WRITE(6,26) PAYCAP(I),RTEARN(I),SHARES(I),ORCARY(I),OTHLOS(I),
     1 PAY(I), NETINC(I), EMPBEN(I)
      WRITE(6,19)((LESSEE(I,K), K=1,20) , I=1,NPLAY)
      WRITE(6,19) LEASE
      WRITE(6,19) NWELLS
      WRITE(6,19) NPDATE
      WRITE(6,15) RESORS
```

```
      WRITE(6,26) EQLIFE
      WRITE(6,28) EQAGE
      WRITE(6,15) TANG
      WRITE (6,1)
      WRITE(6,15) INTANG
      WRITE(6,19) IFLECT
      WRITE(6,17) VCFACT
      WRITE(6,15) ACRES
      WRITE(6,17) GEOFAC
      WRITE(6,21) LESFAC
      WRITE(6,21) TIME
      WRITE(6,21) QZERO
      WRITE(6,30) DZERO
      WRITE(6,19) NO
      WRITE(6,15) BIDMIN
      WRITE (6,1)
      WRITE(6,10) (WELNUM(I,1), I=1,1000)
      WRITE (6,1)
      WRITE(6,17) (WELNUM(I,2), I=1,1000)
      WRITE (6,1)
      WRITE(6,15) EQCOST
      WRITE(6,15) PINT
      WRITE(6,21) VISCTY
      WRITE(6,17) FVF
      WRITE (6,15) GORINT
      IF (JUMP.GT.0) GO TO 999
  115 CONTINUE
      WRITE (6,1)
      DO 120 I = 1,56
      GASPRD(I) = 0.0
      REVNUE(I) = 0.0
      ROYLTY(I) = 0.0
      GROSS(I) = 0.0
      OPCOST(I) = 0.0
      DEPREC(I) = 0.0
      DEPLET(I) = 0.0
      BTXNET(I) = 0.0
      DRILCS(I) = 0.0
      XLOSS(I) = 0.0
      IF (VCFACT(I).EQ.0.0) VCFACT(I) = VARCOS
  120 CONTINUE
C **** READ IN PLAYER DECISIONS.
      DO 130 I = 1,NPLAY
      READ (5,11) DIVDND(I), REGLNS(I), REQBND(I), REQINV(I), SOLDST(I),
     1 REQPAY(I), OPRES(I), FRINGE(I)
      WRITE(6,26) DIVDND(I), REGLNS(I), REQBND(I), REQINV(I), SOLDST(I),
     1 REQPAY(I), OPRES(I), FRINGE(I)
      READ (5,11) (BID(I,J,1), J=1,8)
      WRITE(6,15) (BID(I,J,1), J=1,8)
      READ (5,11) (BID(I,J,2), J=1,8)
      WRITE(6,15) (BID(I,J,2), J=1,8)
      READ (5,11) (RVERSN(I,J), J=1,4), (ABAND(I,J), J=1,4)
      WRITE(6,15) (RVERSN(I,J), J=1,4), (ABAND(I,J), J=1,4)
      READ (5,11) (RENEW(I,J,1), J=1,8)
      WRITE(6,15) (RENEW(I,J,1), J=1,8)
      READ (5,11) (RENEW(I,J,2), J=1,8)
      WRITE(6,15) (RENEW(I,J,2), J=1,8)
      READ (5,12) (NELECT(I,J,1),J=1,8)
      WRITE(6,22) (NELECT(I,J,1),J=1,8)
      READ (5,12) (NELECT(I,J,2),J=1,8)
```

```
      WRITE(6,22) (NELECT(I,J,2),J=1,8)
      READ (5,25) (XDRILL(I,J,1), J=1,8)
      WRITE(6,15) (XDRILL(I,J,1), J=1,8)
      READ (5,25) (XDRILL(I,J,2), J=1,8)
      WRITE(6,15) (XDRILL(I,J,2), J=1,8)
      READ (5,25) (REQFRC(I,J),J=1,4), (REQACD(I,J),J=1,4)
      WRITE(6,15) (REQFRC(I,J),J=1,4), (REQACD(I,J),J=1,4)
      READ (5,25) (REQPMP(I,J),J=1,4), (REQSEC(I,J),J=1,4)
      WRITE(6,15) (REQPMP(I,J),J=1,4), (REQSEC(I,J),J=1,4)
      IF (LENGTH.EQ.0) GO TO 130
      IF (REQLNS(I).LT.0.1) GO TO 127
      CRATIO = (CASH(I) + ACCREC(I))/(ACCPAY(I) + STLOAN(I))
      IF (CRATIO.LE.2.0) REQLNS(I) = 0.0
      IF (CRATIO.LE.2.0) GO TO 129
      TEMP = (CASH(I) + ACCREC(I) - 2.0 * ACCPAY(I))/2.0 - STLOAN(I)
      IF (REQLNS(I).LE.TEMP) GO TO 129
      REQLNS(I) = TEMP
  127 IF (REQLNS(I).LT.(-0.1)) GO TO 128
      GO TO 129
  128 STLOAN(I) = STLOAN(I) + REQLNS(I)
      CASH(I) = CASH(I) + REQLNS(I)
      REQLNS(I) = 0.0
  129 TEMP = XLNGTH/TERMSR
      IF (TEMP.GT.1.0) TEMP = 1.0
      CASH(I) = CASH(I) + ACCREC(I) * TEMP
      ACCREC(I) = ACCREC(I) * (1.0 - TEMP)
      TEMP = XLNGTH/TERMSP
      IF (TEMP.GT.1.0) TEMP = 1.0
      CASH(I) = CASH(I) - ACCPAY(I) * TEMP
      ACCPAY(I) = ACCPAY(I) * (1.0 - TEMP)
      XTEMP(I) = OTHLOS(I)
  130 CONTINUE
      II = 0
C  ****  CHECK TO SEE IF LEASE IS FOR SALE.
  189 II = II + 1
      IF(II.GT.56) GO TO 199
      IF (LEASE(II).GT.0) GO TO 200
      GO TO 189
  200 TEMP = LEASE(II)
  216 NCHECK = 0
      NEQUAL = 0
      DO 201 I = 1,NPLAY
      DO 202 J = 1,8
C  ****  CHECK PLAYERS BIDS FOR BIDS ON THE FIRST AVAILABLE LEASE.
      IF (BID(I,J,1).LT.0.01) GO TO 202
      IF (BID(I,J,1).EQ.TEMP.AND.NCHECK.EQ.0) GO TO 224
      IF (BID(I,J,1).EQ.TEMP) GO TO 203
      GO TO 202
  224 IF (BIDMIN(II).GT.BID(I,J,2)) GO TO 201
  206 HOLD2 = BID(I,J,2)
      NEQUAL = 1
      IDENT(1) = I
      NCHECK = 1
      GO TO 201
  203 IF (BID(I,J,2).GT.HOLD2) GO TO 206
      IF (BID(I,J,2).NE.HOLD2) GO TO 201
      NEQUAL = NEQUAL + 1
      IDENT(NEQUAL) = I
      GO TO 201
  202 CONTINUE
```

```
201 CONTINUE
    IF(NEQUAL.EQ.1) GO TO 210
    IF (NEQUAL.EQ.0.AND.NDEAL.EQ.0) GO TO 189
    IF (NEQUAL.EQ.0.AND.NDEAL.GE.1) GO TO 199
209 CALL RANDNO (RNUM)
    X = 0.0
    Z = NEQUAL
    Y = 1.0/Z
    T = Y
    DO 207 I = 1,NEQUAL
    IF (RNUM.GT.X.AND.RNUM.LE.Y) GO TO 208
    X = Y
    Y = Y + T
    IF (Y.GE.1.0) Y = 1.0
207 CONTINUE
208 I = IDENT(I)
214 CONTINUE
    DO 211 J = 1,MAXOWN
    IF (LESSEE(I,J).EQ.0) GO TO 212
211 CONTINUE
212 LESSEE(I,J) = TEMP
    LEASE(II) = 0
    GO TO 213
210 I = IDENT(1)
    GO TO 214
213 CASH(I) = CASH(I) - HOLD2 * CASHFT
    ACCPAY(I) = ACCPAY(I) + HOLD2 * (1. - CASHFT)
    IF (NDEAL.GT.0) GO TO 220
    GO TO 221
220 HOLD1 = TANG(II) + INTANG(II)
    IF (HOLD2.GT.HOLD1.AND.MESES-NPDATE(II).GT.6) GAINLT(NDEAL) =
   1 GAINLT(NDEAL) + HOLD2 - HOLD1
    IF (HOLD2.LT.HOLD1.AND.MESES-NPDATE(II).GT.6) XLOSLT(NDEAL) =
   1 XLOSLT(NDEAL) + HOLD1 - HOLD2
    IF (MESES - NPDATE(II).LE.6.AND.HOLD1.GT.HOLD2)
   1XLOSLT(NDEAL) = XLOSLT(NDEAL) - HOLD2 + HOLD1
    IF (MESES - NPDATE(II).LE.6.AND.HOLD1.LT.HOLD2)
   1 OTHINC(NDEAL) = OTHINC(NDEAL) + HOLD2 - HOLD1
    CASH(NDEAL) = CASH(NDEAL) + HOLD2 * CASHFT
    ACCREC(NDEAL) = ACCREC(NDEAL) + HOLD2 * (1.-- CASHFT)
221 IF (NWELLS(II).NE.0.AND.NDEAL.EQ.0) EQCOST(II) = HOLD2 * EQCSFT
    IF (NDEAL.EQ.0) TANG(II) = EQCOST(II)
    NPDATE(II) = MESES + 1
    INTANG(II) = HOLD2 - TANG(II)
    HOLD1 = 0.0
    HOLD2 = 0.0
    IF (NDEAL.GT.0) GO TO 199
    GO TO 189
199 CONTINUE
    NDEAL = 0
    DO 231 I = 1,NPLAY
    DO 231 J = 1,8
    IF (BID(I,J,1).LT.(-0.01)) GO TO 233
    GO TO 231
233 II = -BID(I,J,1)
    DO 234 K = 1,MAXOWN
    IF (II.EQ.LESSEE(I,K)) GO TO 235
234 CONTINUE
    GO TO 236
235 BIDMIN(II) = BID(I,J,2)
```

```
      LESSEE(I,K) = 0
      TEMP = II
      BID(I,J,1) = 0.0
      BID(I,J,2) = 0.0
      NDEAL = I
      GO TO 216
  236 PENSEL(I,2) = PENSEL(I,2) + FINE
      PENSEL(I,1) = -BID(I,J,1)
      BID(I,J,1) = 0.0
  231 CONTINUE
C  ****  LEASE REVERSION.
      DO 241 I = 1,NPLAY
      DO 241 J = 1,4
      IF (RVERSN(I,J).LT.0.01) GO TO 241
      II = RVERSN(I,J)
      IF (NWELLS(II).GT.0) GO TO 241
      DO 244 K = 1,MAXOWN
      IF (LESSEE(I,K).EQ.II) GO TO 245
  244 CONTINUE
      GO TO 243
  245 LEASE(II) = II
      RVERSN(I,J) = 0.0
      LESSEE(I,K) = 0
      IF (MESES-NPDATE(II).LE.6) XLOSLT(I) = XLOSLT(I) + INTANG(II)
      IF (MESES-NPDATE(II).GT.6) XLOSLT(I) = XLOSLT(I) + INTANG(II)
      INTANG(II) = 0.0
      GO TO 241
  243 PENRVT(I,2) = PENRVT(I,2) + FINE .
      PENRVT(I,1) = RVERSN(I,J)
      RVERSN(I,J) = 0.0
  241 CONTINUE
C  ****  LEASE ABANDONMENT.
      DO 251 I = 1,NPLAY
      DO 252 J = 1,4
      IF (ABAND(I,J).LT.0.01) GO TO 251
      II = ABAND(I,J)
      DO 253 K = 1,MAXOWN
      IF (LESSEE(I,K).EQ.II) GO TO 254
  253 CONTINUE
      PENABD(I,1) = ABAND(I,J)
      PENABD(I,2) = PENABD(I,2) + FINE
      GO TO 251
  254 WELLS = NWELLS(II)
      ABDCOS(I) = ABDCOS(I) + WELLS * ABDNFT
      IF (MESES-NPDATE(II).LE.6) OTHLOS(I) = OTHLOS(I) + INTANG(II)
     1 + TANG(II)
      IF (MESES-NPDATE(II).GT.6) XLOSLT(I) = XLOSLT(I) + INTANG(II)
     1 + TANG(II)
      INTANG(II) = 0.0
      TANG(II) = 0.0
      LESSEE(I,K) = 0
      NWELLS(II) = 0
      LESFAC(II) = 0.0
  252 CONTINUE
  251 CONTINUE
      TEMP = 0.0
      HOLD1 = 0.0
      HOLD2 = 0.0
      DO 300 I = 1,NPLAY
      IF (BENFIT.GT.0.01) FRINGE(I) = BENFIT
```

```
      IF (REQPAY(I).GT.1.1*PAYBAS) REQPAY(I) = 1.1 * PAYBAS
      IF (REQPAY(I).LT.0.9*PAYBAS) REQPAY(I) = 0.9 * PAYBAS
      IF (RLABOR.GT.0.1) REQPAY(I) = RLABOR
      IF (FRINGE(I).GT.2.0*BENBAS) FRINGE(I) = 2.0 * BENBAS
      IF (REQPAY(I).GT.0.1) PAY(I) = REQPAY(I)
      IF (FRINGE(I).GT.0.01) EMPBEN(I) = FRINGE(I)
      TEMP = TEMP + PAY(I)
      NETINC(I) = NETINC(I) * XLNGTH
      HOLD1 = HOLD1 + NETINC(I)
  300 HOLD2 = HOLD2 + EMPBEN(I)
      X = NPLAY
      PAYAVG = TEMP/X
      BENAVG = HOLD2/X
      AVGINC = HOLD1/X
      SALE = 0.0
      DO 310 I = 1,56
      IF (LEASE(I).GT.0) SALE = SALE + 1.0
  310 CONTINUE
      MONTH = MONTH + LENGTH - 1
      IF (MONTH.GT.12) GO TO 801
      GO TO 802
  801 MONTH = MONTH - 12
      NYEAR = NYEAR + 1
  802 ITEMP = MESFS
      DO 601 I = 1,NPLAY
      ISTRIK = 0
      STRIKE = (1.0 - PAY(I)/PAYAVG) + (1.0 - PAY(I)/PAYBAS)
      STRIK2 = (1.0 - EMPBEN(I)/BENAVG) + (1.0 - EMPBEN(I)/BENBAS)
      IF (STKFAC.LE.0.0) STKFAC = 0.001
      STRIKE = (STRIKE + STRIK2) * STKFAC
      IF (STRIKE.LT.0.0) STRIKE = 0.0
      IF (STRIKE.GT.1.0) STRIKE = 1.0
      CALL RANDNO(RNUM)
      IF (RNUM.GT.0.0.AND.RNUM.LT.STRIKE) ISTRIK = 1
  630 OWN = 0.0
      EMERG = 0.0
      TOTTAN = 0.0
      TOTINT = 0.0
      DELAYR = 0.0
      DRILL = 0.0
      TOTREV = 0.0
      TOTRYL = 0.0
      TOTOPC = 0.0
      TOTDPR = 0.0
      TOTDPL = 0.0
      TOTRES = 0.0
      TOTGRO = 0.0
      TOTGAS = 0.0
      ADD = 0.0
      TOTOIL = 0.0
      OTHEXP = 0.0
      KOUNT = 0
      FUDGE = 0.0
      TOTHRS = 0.0
      WRITE (6,1)
      DO 602 J = 1,MAXOWN
      IF (LESSEE(I,J).GT.0) GO TO 603
      GO TO 602
  603 II = LESSEE(I,J)
      OWN = OWN + 1.0
```

```
      TEMP = II                                                         PDT 417
      MESES = ITEMP                                                     PDT 418
      DO 632 JJ = 1,LENGTH                                              PDT 419
      IF (NWELLS(II).EQ.0) GO TO 633                                    PDT 420
      IF (ISTRIK.EQ.1.AND.JJ.LT.3) GO TO 632                            PDT 421
      OIL1 = QZERO(II)/EXP(DZERO(II) * TIME(II))                        PDT 422
      OIL2 = QZERO(II)/EXP(DZERO(II) * (TIME(II) + 1.0))                PDT 423
      OILFAC = (OIL1 + OIL2)/2.0                                        PDT 424
      DO 648 K = 1,4                                                    PDT 425
      IF (REQFRC(I,K).EQ.TEMP) GO TO 633                                PDT 426
      IF (REQACD(I,K).EQ.TEMP) GO TO 633                                PDT 427
      IF (REQPMP(I,K).EQ.TEMP) GO TO 690                                PDT 428
      IF (REQSEC(I,K).EQ.TEMP) GO TO 691                                PDT 429
  648 CONTINUE                                                          PDT 430
  680 CONTINUE                                                          PDT 431
      IF (OILFAC.LT.0.01) GO TO 616                                     PDT 432
      GFAC = GORINT(II)/10.                                             PDT 433
      GOR1= (1. + SIN(3.141659 * (3./2. + TIME(II)/GFAC)))  *           PDT 434
     1 QZERO(II) * (10. /DZERO(II))/OIL1 + GO-+NT(II)                   PDT 435
      GOR2= (1. + SIN(3.141659 * (3./2. + (TIME(II) + 1.0)/GFAC))) *    PDT 436
     1 QZERO(II) * (10. /DZERO(II))/OIL2 + GORINT(II)                   PDT 437
      GOR = (GOR1 + GOR2)/2.0                                           PDT 438
      IF (GOR.LT.GORINT(II)*0.9) GOR = GORINT(II) * 0.9                 PDT 440
      OILFAC = OILFAC * 30.                                             PDT 441
      PRDOIL = 0.0                                                      PDT 442
      PRDGAS = 0.0                                                      PDT 443
      DO 683 K = 1,1000                                                 PDT 444
      IF (WELNUM(K,1).EQ.TEMP)GO TO 684                                 PDT 445
      GO TO 683                                                         PDT 446
  684 PRDOIL = PRDOIL + OILFAC * WELNUM(K,2)                            PDT 447
  683 CONTINUF                                                          PDT 448
      HOLD2 = PRDOIL                                                    PDT 449
      X = NWELLS(II)                                                    PDT 450
      IF (PRDOIL.GT.X*OILALW) PRDOIL = X * OILALW                       PDT 451
      PRDGAS = PRDOIL * GOR * .001                                      PDT 452
      IF (PRDGAS.GT.X*GASALW) PRDOIL = GASALW * X/(GOR * .001)          PDT 453
      PRDGAS = PRDOIL * GOR * .001                                      PDT 454
      OILPRD(II) = OILPRD(II) + PRDOIL                                  PDT 455
      GASPRD(II) = GASPRD(II) + PRDGAS                                  PDT 456
      TIME(II) = TIME(II) + PRDOIL/HOLD2                                PDT 457
  633 CONTINUE                                                          PDT 458
      DO 650 K = 1,8                                                    PDT 459
      KK = K                                                            PDT 460
      IF (XDRILL(I,K,1).EQ.TEMP.AND.NWELLS(II).EQ.0) GO TO 658          PDT 461
      IF (XDRILL(I,K,1).EQ.TEMP.AND.XDRILL(I,K,2).GT.0.1) GO TO 651     PDT 462
  650 CONTINUE                                                          PDT 463
      IF (NWELLS(II).GT.0) GO TO 676                                    PDT 464
      IF (MESES-NPDATE(II).GT.12) GO TO 657                             PDT 465
      IF (MESES - NPDATE(II).GT.60) GO TO 636                           PDT 4651
      GO TO 621                                                         PDT 466
  657 DELAYR = DELAYR * ACRES(II)/12.0                                  PDT 467
      GO TO 621                                                         PDT 4680
  636 LEASE(II) = II                                                    PDT 4681
      LESSEE(I,J) = 0                                                   PDT 4682
      XLOSLT(II) = XLOSLT(II) + INTANG(II)                              PDT 4683
      INTANG(II) = 0.0                                                  PDT 4684
      GO TO 621                                                         PDT 4685
  651 KOUNT = KOUNT + 1                                                 PDT 469
      IF (KOUNT.EQ.1) WRITE (6,1100) I                                  PDT 470
      IF (JJ.EQ.1) WRITE (6,1101) II                                    PDT 471
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      IF (XDRILL(I,K,2).GT.4.0) GO TO 634
      N = XDRILL(I,K,2)
      XDRILL(I,K,2) = 0.0
      GO TO 635
  634 N = 4
      XDRILL(I,K,2) = XDRILL(I,K,2) - 4.0
  635 CONTINUE
      DO 652 K = 1,N
      CALL RANDNO(RNUM)
      IF (LESFAC(II).LT.0.001) GO TO 659
      IF (LESFAC(II)-RNUM.LE.0.0) RNUM = LESFAC(II)
      WELNUM(LASTNM,1) = II
      WELNUM(LASTNM,2) = RNUM
      LESFAC(II) = LESFAC(II) - RNUM
      NWELLS(II) = NWELLS(II) + 1
      HOLD2 = QZERO(II) * RNUM
      OILFAC = (HOLD2 - HOLD2/EXP(DZERO(II)))/2.0
      PI = OILFAC/((PINT(II) - PINT(II)/EXP(DZERO(II) * 1.4))/2.0)
      WRITE (6,1114) JJ, K, OIL, HOLD2, PINT(II), PI
      DRILCS(II) = DRILCS(II) + DRINTG
      CASH(I) = CASH(I) - CASHFT * DRTANG
      ACCPAY(I) = ACCPAY(I) + (1.0 - CASHFT) * DRTANG
      TANG(II) = TANG(II) + DRTANG
      EQCOST(II) = EQCOST(II) + DRTANG
      LASTNM = LASTNM + 1
      IF (NO(II).LT.40) EANDD(I) = EANDD(I) + FRCCOS
      IF (NO(II).LT.25) EANDD(I) = EANDD(I) + PMPCOS
  652 CONTINUE
      GO TO 676
  658 KOUNT = KOUNT + 1
      IF (KOUNT.EQ.1) WRITE (6,1100) I
      IF (JJ.EQ.1) WRITE (6,1101) II
      XDRILL(I,K,2) = XDRILL(I,K,2) - 1.0
      CALL RANDNO(RNUM)
      IF (RNUM.GT.GEOFAC(II)) GO TO 659
      GO TO 660
  659 GEOFAC(II) = 0.0
      HOLD2 = 0.0
      IF (NWELLS(II).EQ.0) K = 1
      WRITE (6,1103) JJ, K, DRY, HOLD2
      EANDD(I) = EANDD(I) + DRYHCS
      XDRILL(I,KK,1) = 0.0
      XDRILL(I,KK,2) = 0.0
      IF (NWELLS(II).GT.0) GO TO 676
      GO TO 621
  660 X = 0.0
      W = 0.0
      CALL RANDNO(RNUM)
      DO 661 K = 1,9
      W = W + FLOAT(K)
      Y = W/45.
      IF (RNUM.GT.X.AND.RNUM.LE.Y) GO TO 662
  661 X = Y
      GO TO 616
  662 CALL RANDNO(RNUM)
      GO TO (663,664,665,666,667,668,669,670,671),K
  663 CALL RANDNO(RNUM)
      IF (RNUM.LT.0.5) GO TO 663
      RESORS(II) = RNUM * 16460000.
      LESFAC(II) = RESORS(II) * .000002
```

```
      DZERO(II) = 0.033333
      QZERO(II) = 1./.000004 * DZERO(II)/.995
      PINT(II) = 1000. + RNUM * 4000.
      FVF(II) = 1.1 + RNUM * .4
      GO TO 675
  664 RESORS(II) = (263. + RNUM * 560.) * 10000.
      LESFAC(II) = RESORS(II) * .000003
      DZERO(II) = 0.034167
      QZERO(II) = 1./.000006 * DZERO(II)/.995
      PINT(II) = 1000. + RNUM * 4000.
      FVF(II) = 1.1 + RNUM * .4
      GO TO 675
  665 RESORS(II) = (120. + RNUM * 116.) * 10000.
      LESFAC(II) = RESORS(II) * .000006
      DZERO(II) = 0.035
      QZERO(II) = 1./.000012 * DZERO(II)/.995
      PINT(II) = 1000. + RNUM * 4000.
      FVF(II) = 1.1 + RNUM * .4
      GO TO 675
  666 RESORS(II) = (58.4 + RNUM * 61.6) * 10000.
      LESFAC(II) = RESORS(II) * .000009
      DZERO(II) = 0.035833
      QZERO(II) = 1./.000018 * DZERO(II)/.995
      PINT(II) = 1000. + RNUM * 4000.
      FVF(II) = 1.1 + RNUM * .4
      GO TO 675
  667 RESORS(II) = (41.2 + RNUM * 17.2) * 10000.
      LESFAC(II) = RESORS(II) * .000012
      DZERO(II) = 0.036667
      QZERO(II) = 1./.000024 * DZERO(II)/.995
      PINT(II) = 1000. + RNUM * 4000.
      FVF(II) = 1.1 + RNUM * .4
      GO TO 675
  668 RESORS(II) = (17.15 + RNUM * 24.05) * 10000.
      LESFAC(II) = RESORS(II) * .0000137
      DZERO(II) = 0.0375
      QZERO(II) = 1./.0000274 * DZERO(II)/.995
      PINT(II) = 1000. + RNUM * 4000.
      FVF(II) = 1.1 + RNUM * .4
      GO TO 675
  669 RESORS(II) = (10.3 + RNUM * 7.12) * 10000.
      LESFAC(II) = RESORS(II) * .0000256
      DZERO(II) = 0.038333
      QZERO(II) = 1./.0000512 * DZERO(II)/.995
      PINT(II) = 1000. + RNUM * 4000.
      FVF(II) = 1.1 + RNUM * .4
      GO TO 675
  670 RESORS(II) = (3.2 + RNUM * 7.1) * 10000.
      LESFAC(II) = RESORS(II) * .000035
      DZERO(II) = 0.039167
      QZERO(II) = 1./.000070 * DZERO(II)/.995
      PINT(II) = 1000. + RNUM * 4000.
      FVF(II) = 1.1 + RNUM * .4
      GO TO 675
  671 RESORS(II) = (1.76 + RNUM * 1.44) * 10000.
      LESFAC(II) = RESORS(II) * .00008
      DZERO(II) = 0.04
      QZERO(II) = 1./.00016 * DZERO(II)/.995
      PINT(II) = 1000. + RNUM * 4000.
      FVF(II) = 1.1 + RNUM * .4
```

```
675 CALL RANDNO(RNUM)
    WELNUM(LASTNM,1) = II
    WELNUM(LASTNM,2) = RNUM
    LASTNM = LASTNM + 1
    LESFAC(II) = LESFAC(II) - RNUM
    K = I
    HOLD2 = QZERO(II) * RNUM
    OILFAC = (HOLD2 - HOLD2/EXP(DZERO(II)))/2.0
    PI = OILFAC/((PINT(II) - PINT(II)/EXP(DZERO(II) * 1.4))/2.0)
    CALL RANDNO(RNUM)
    VISCTY(II) = 0.1 + 20. * RNUM
    CALL RANDNO(RNUM)
    GORINT(II) = 1000. * RNUM
672 PAYOUT = 7.08 * PI/(VISCTY(II) * FVF(II) * 7.6)
    IF (PAYOUT.LT.0.05.AND.VISCTY(II).GT.2.0) GO TO 673
    GO TO 674
673 VISCTY(II) = VISCTY(II) - .1
    GO TO 672
674 WRITE (6,1109) JJ,K,OIL,HOLD2,PINT(II),PI,VISCTY(II),FVF(II)
    NWELLS(II) = 1
    DRILCS(II) = DRILCS(II) + DRINTG
    CASH(I) = CASH(I) - CASHFT * DRTANG
    ACCPAY(I) = ACCPAY(I) + (1.0 - CASHFT) * DRTANG
    TANG(II) = TANG(II) + DRTANG
    EQCOST(II) = EQCOST(II) + DRTANG
676 X = NWELLS(II)
    DO 677 K = 1,4
    IF (REQFRC(I,K).EQ.TEMP) GO TO 685
    IF (REQACD(I,K).EQ.TEMP) GO TO 686
677 CONTINUE
    GO TO 632
685 REQFRC(I,K) = 0.0
    IF (NO(II).NE.30.OR.NO(II).NE.40) GO TO 687
    NO(II) = NO(II) - 5
    CALL RANDNO (RNUM)
    IF (RNUM.LT.FRCFAC) GO TO 687
    QZERO(II) = QZERO(II) * FRFLOW
    DZERO(II) = DZERO(II) * DECLN
    Z = X * FRCCOS
    KOUNT = KOUNT + 1
    IF (KOUNT.EQ.1) WRITE (6,1100) I
    WRITE (6,1104) II
    WRITE (6,1105) X, Z
    GO TO 631
687 EANDD(I) = EANDD(I) + FRCCOS
    KOUNT = KOUNT + 1
    IF (KOUNT.EQ.1) WRITE (6,1100) I
    WRITE (6,1104) II
    WRITE (6,1110) FRCCOS
    GO TO 632
686 REQACD(I,K) = 0.0
    IF (NO(II).LE.30) GO TO 688
    NO(II) = NO(II) - 10
    CALL RANDNO(RNUM)
    IF (RNUM.LT.ACDFAC) GO TO 688
    QZERO(II) = QZERO(II) * ACFLOW
    DZERO(II) = DZERO(II) * DECLN
    Z = X * ACDCOS
    KOUNT = KOUNT + 1
    IF (KOUNT.EQ.1) WRITE (6,1100) I
```

```
      WRITE (6,1106) II
      WRITE (6,1107) X, Z
      GO TO 631
  688 EANDD(I) = EANDD(I) + ACDCOS
      KOUNT = KOUNT + 1
      IF (KOUNT.EQ.1) WRITE (6,1100) I
      WRITE (6,1106) II
      WRITE (6,1111) ACDCOS
      GO TO 632
  690 REQPMP(I,K) = 0.0
      IF (OILFAC.GE.OILALW) GO TO 632
      IF (NO(II).LE.15) GO TO 632
      QZERO(II) = QZERO(II) * PMFLOW
      DZERO(II) = DZERO(II) * DECLN
      NO(II) = 15
      Z = X * PMPCOS
      VCFACT(II) = VCFACT(II) * 1.1
      KOUNT = KOUNT + 1
      IF (KOUNT.EQ.1) WRITE (6,1100) I
      WRITE (6,1112) II, X, Z
      GO TO 631
  691 REQSEC(I,K) = 0.0
      IF (OILFAC.GE.OILALW) GO TO 632
      IF (NO(II).EQ.0) GO TO 632
      QZERO(II) = QZERO(II) * SRFLOW
      DZERO(II) = DZERO(II) * .9
      VCFACT(II) = VCFACT(II) * 1.3
      Z = X * SECCOS
      KOUNT = KOUNT + 1
      IF (KOUNT.EQ.1) WRITE (6,1100) I
      NO(II) = 0
      WRITE (6,1113) II, Z
  631 EANDD(I) = EANDD(I) + Z * 0.4
      Y = Z * 0.6
      TANG(II) = TANG(II) + Y
      CASH(I) = CASH(I) - Y * CASHFT
      ACCPAY(I) = ACCPAY(I) + (1. - CASHFT) * Y
      EQCOST(II) = EQCOST(II) + Y
  632 MESES = MESES + 1
C  ****  COMPUTE TOTAL REVENUE, ROYALTIES AND GROSS INCOME.
      REVNUE(II) = OILPRD(II) * OPRICE + GASPRD(II) * GPRICE
      ROYLTY(II) = ROYL * REVNUE(II)
      GROSS(II) = REVNUE(II) - ROYLTY(II)
C  ****  CHECK TO SEE IF PLAYER HAS RENEWED EQUIPMENT ON LEASE.
      DO 604 K = 1,8
      IF (RENEW(I,K,1).LE.0.01) GO TO 608
      N = RENEW(I,K,1)
      IF (N.EQ.LESSEE(I,J)) GO TO 605
  604 CONTINUE
      GO TO 608
  605 FACTOR = (EQCOST(II) - TANG(II))/RENEW(I,K,2)
      IF (FACTOR.LT.0.75) FACTOR = 0.75
      IF (FACTOR.GT.20.0) FACTOR = 20.0
      TANG(II) = TANG(II) + RENEW(I,K,2)
      IF (EQCOST(II).LT.TANG(II)) EQCOST(II) = TANG(II)
      IF (IELECT(II).GT.3) IELECT(II) = 1
      CASH(I) = CASH(I) - RENEW(I,K,2) * CASHFT
      ACCPAY(I) = ACCPAY(I) + RENEW(I,K,2) * (1. - CASHFT)
      IF (FACTOR.GT.1.0) GO TO 607
      VCFACT(II) = VCFACT(II) * FACTOR
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      EQAGE(II) = 0.0
      EQLIFE(II) = EOLIFE(II)/FACTOR
      GO TO 608
  607 EOLIFE(II) = EOLIFE(II) + EOAGE(II)/FACTOR
  608 TEMP = NWELLS(II) * 10
      TOTHRS = TOTHRS + TEMP
      VAR = VCFACT(II) * EXP(EQAGE(II)/EOLIFE(II))
      OPCOST(II) = XLNGTH * TEMP * (PAY(I) + EMPBEN(I)) + VAR *
     1 OILPRD(II)
      IF (TANG(II).LE.0.0.OR.EOAGE(II).GE.EQLIFE(II)) GO TO 616
C **** CHECK TO SEE IF PLAYER DESIRES TO CHANGE DEPRECIATION METHOD.
      DO 610 K = 1,8
      IF (NELECT(I,K,1).EQ.II) GO TO 611
  610 CONTINUE
      GO TO 612
  611 IF (IELECT(II).EQ.0) IELECT(II) = NELECT(I,K,2)
      IF (IELECT(II).EQ.0) GO TO 616
      IF (NELECT(I,K,2).EQ.IELECT(II)) GO TO 612
      IF (NELECT(I,K,2).EQ.1.AND.IELECT(II).EQ.2) GO TO 620
      PENDEP(I,2) = PENDEP(I,2) + FINE
      PENDEP(I,1) = II
  612 IF (IELECT(II).EQ.0) GO TO 616
      IF (IELECT(II).EQ.1) GO TO 614
      IF (IELECT(II).EQ.2) GO TO 615
      IF (IELECT(II).GT.3) GO TO 609
      TEMP = 0.0
      LIFE = EOLIFE(II)
      DO 640 K = 1,LIFE
      X = K
  640 TEMP = TEMP + X
      X = EQAGE(II)+ 1.0
      IF (EOAGE(II).LE.0.01) X = 0.0
      DO 641 K = 1,LENGTH
      DEPREC(II) = DEPREC(II) + (EOLIFE(II) - X)/TEMP * EOCOST(II)
  641 X = X + 1.0
      GO TO 616
  620 IELECT(II) = 1
  614 DEPREC(II) = TANG(II)/EOLIFE(II)
      IELECT(II) = DEPREC(II)
      GO TO 616
  609 DEPREC(II) = IELECT(II)
      GO TO 616
C **** COMPUTE DEPRECIATION BY THE DECLINING BALANCE METHOD.
  615 DRATE = 24./EQLIFE(II)
      IF (MESES.EQ.0) GO TO 613
      TEMP = MESES/12
      TEMP = EOCOST(II) * (1.0 - DRATE)**TEMP
      GO TO 619
  613 TEMP = TANG(II)
  619 DEPREC(II) = DRATE * TEMP * TIMFAC
  616 EQAGE(II) = EOAGE(II) + XLNGTH
      TANG(II) = TANG(II) - DEPREC(II)
C **** COMPUTE NET BEFORE DEPLETION.
      TEMP = GROSS(II) - XLOSS(II) - DEPREC(II) - DRILCS(II) -OPCOST(II)
      DRILL = DRILL + DRILCS(II)
C **** COMPUTE COST DEPLETION.
      HOLD2 = INTANG(II) * OILPRD(II)/RESORS(II)
      RESORS(II) = RESORS(II) - OILPRD(II)
C **** COMPUTE PERCENTAGE DEPLETION.
      IF (TEMP.LE.HOLD2) GO TO 617
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      PERDPL = 0.275 * GROSS(II)
      IF (PERDPL.GT.(0.5 * TEMP)) PERDPL = 0.5 * TEMP
      IF (PERDPL.GT.HOLD2) DEPLET(II) = PERDPL
      IF (PERDPL.LE.HOLD2) DEPLET(II) = HOLD2
      GO TO 623
  617 DEPLET(II) = HOLD2
  623 BTXNET(II) = TEMP - DEPLET(II)
      INTANG(II) = INTANG(II) - DEPLET(II)
      IF (INTANG(II).LT.0.0) ADD = ADD - INTANG(II)
      IF (INTANG(II).LT.0.0) INTANG(II) = 0.0
C  ****  COMPANY ACCOUNTING.
  621 TOTREV = TOTREV + REVNUE(II)
      TOTOIL = TOTOIL + OILPRD(II)
      TOTGAS = TOTGAS + GASPRD(II)
      TOTGRO = TOTGRO + GROSS(II)
      TOTRYL = TOTRYL + ROYLTY(II)
      TOTOPC = TOTOPC + OPCOST(II)
      TOTDPR = TOTDPR + DEPREC(II)
      TOTDPL = TOTDPL + DEPLET(II)
      TOTTAN = TOTTAN + TANG(II)
      TOTINT = TOTINT + INTANG(II)
      OPCOST(II) = OPCOST(II) + DRILCS(II)
  602 CONTINUE
      MESES = ITEMP + LENGTH
      IF (REQBND(I).LT.0.1) GO TO 706
      TEMP = PAYCAP(I) + RTEARN(I)
      IF (BONDS(I).GE.TEMP) REQBND(I) = 0.0
      IF (BONDS(I).LT.TEMP) TEMP = TEMP - BONDS(I)
      IF (TEMP.GE.REQBND(I)) GO TO 706
      REQBND(I) = TEMP
  706 DIVREC = DVRATE * INVEST(I) * TIMFAC
      INTPAY = (STLOAN(I) * STRATE + BONDS(I) * BDRATE) * TIMFAC
      IF (GAINLT(I).GT.XLOSLT(I)) GAINLT(I) = GAINLT(I) - XLOSLT(I)
      IF (GAINLT(I).GT.XLOSLT(I)) XLOSLT(I) = 0.0
      IF (GAINLT(I).LE.XLOSLT(I)) XLOSLT(I) = XLOSLT(I) - GAINLT(I)
      IF (GAINLT(I).LE.XLOSLT(I)) GAINLT(I) = 0.0
      CPGAIN = GAINLT(I) + OTHINC(I)
      CPLOSS = XLOSLT(I) + OTHLOS(I)
      CASH(I) = CASH(I) + DIVREC - INTPAY + TOTREV * CASHFT
      ACCREC(I) = ACCREC(I) + TOTREV * (1. - CASHFT)
      DIVPAY = DIVDND(I) * SHARES(I)
      XDRIL = DRILL * CASHFT
      ACCPAY(I) = ACCPAY(I) + DRILL * (1. - CASHFT)
      PENLTY = PENSEL(I,2) + PENRVT(I,2) + PENABD(I,2) + PENDEP(I,2)
      REDEEM = BONDS(I) * TIMFAC * .05
      ACCPAY(I) = ACCPAY(I) + EANDD(I) * (1. - CASHFT)
      CASH(I) = CASH(I) - TOTRYL - DELAYR - XDRIL - TOTOPC -
     1 OPRES(I) - ABDCOS(I) - REDEEM - EANDD(I) * CASHFT - PENLTY
      INVEST(I) = INVEST(I) + REQINV(I)
      BONDS(I) = BONDS(I) + REQBND(I) - REDEEM
      ADMIN = ASSETS(I) * .02
      IF (ORCARY(I).LE.0.0) GO TO 707
      X = ADMIN * ORCARY(I)/ORBASE * 0.1
      IF (X.GT.ADMIN*0.5) X = ADMIN * 0.5
      ADMIN = ADMIN - X
  707 IF (LENGTH.EQ.0) ADMIN = 0.0
      ORCARY(I) = ORCARY(I) + OPRES(I)
      CASH(I) = CASH(I) - REQINV(I)  + REQBND(I) + REQLNS(I) - ADMIN
      TOTOPE = TOTRYL + DELAYR + DRILL + TOTOPC + TOTDPR + TOTDPL
     1 + ABDCOS(I)
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      OPNET = TOTREV - TOTOPE
      TOTINC = CPGAIN + DIVREC
      OTHEXP = INTPAY + ADMIN + EANDD(I) + OPRES(I) + CPLOSS
      HOLD1 = 0.85 * DIVREC
      PRETAX = OPNET + TOTINC - OTHEXP - HOLD1 - GAINLT(I)
      STATAX = STAXR * TOTGRO
      FEDTAX = FTAXR * (PRETAX - STATAX)
      IF (PRETAX-STATAX.LT.0.0) FEDTAX = 0.0
      IF (PRETAX-STATAX.LT.0.0) OTHLOS(I) = OTHLOS(I) + ABS(PRETAX -
     1 STATAX)
      TAXLTG = .25 * GAINLT(I)
      CASH(I) = CASH(I) - STATAX - FEDTAX - TAXLTG
      NETINC(I) = PRETAX - STATAX - FEDTAX - TAXLTG + GAINLT(I) + HOLD1
     1 + ADD + XTEMP(I)
      HOLD2 = RTEARN(I)
      RTEARN(I) = RTEARN(I) + NETINC(I) - PENLTY - DIVPAY
      IF (MESES.EQ.0) GO TO 709
      IF (MQUOTE(I).LT.1.0) MQUOTE(I) = 1.0
      MQUOTE(I) = MQUOTE(I) - MQUOTE(I) * (DIVBAS - DIVDND(I))/DIVBAS *
     1 QUOTET
      MQUOTE(I) = MQUOTE(I) + RTEARN(I) - HOLD2/RTEARN(I) * MQUOTE(I)
      IF (MQUOTE(I).LT.1.0) MQUOTE(I) = 1.0
  709 BISTOK = SOLDST(I) * MQUOTE(I)
      PAYCAP(I) = PAYCAP(I) + BISTOK
      CASH(I) = CASH(I) + BISTOK
      SHARES(I) = SHARES(I) + SOLDST(I)
      IF (SOLDST(I).GT.0.0) GO TO 730
      SELL = 0.0
      BISTOK = ABS(BISTOK)
      GO TO 731
  730 SELL = BISTOK
      BISTOK = 0.0
  731 EQUITY = NETINC(I) - PENLTY - DIVPAY + SELL - BISTOK
      IF (CASH(I).GE.0.0) GO TO 703
      EMERG = ABS(CASH(I)) * 1.1
      CASH(I) = 0.0
  703 STLOAN(I) = STLOAN(I) + REQLNS(I) + EMERG
      ASSETS(I) = CASH(I) + ACCREC(I) + TOTTAN + TOTINT + INVEST(I)
  740 TOTLIB = ACCPAY(I) + STLOAN(I) + BONDS(I) + PAYCAP(I) + RTEARN(I)
      IF (ABS(ASSETS(I)-TOTLIB).GT.1.0) GO TO 741
  742 BOOK = (PAYCAP(I) + RTEARN(I))/SHARES(I)
      DO 601 J = 1,NCOPYS
      WRITE (6,1)
      WRITE (6,1401)
      WRITE (6,3)
      WRITE (6,1402) (LEASE(K), LEASE(K+28), K=1,28)
      WRITE (6,1)
      WRITE (6,1501) I, MONTH, NYEAR
      DO 622 K = 1,MAXOWN,4
      M1 = LESSEE(I,K)
      M2 = LESSEE(I,K+1)
      M3 = LESSEE(I,K+2)
      M4 = LESSEE(I,K+3)
      WRITE (6,1502) M1, M2, M3, M4
      IF (M1.LE.0) M1 = 1
      IF (M2.LE.0) M2 = 1
      IF (M3.LE.0) M3 = 1
      IF (M4.LE.0) M4 = 1
      WRITE (6,1503) OILPRD(M1), OILPRD(M2), OILPRD(M3), OILPRD(M4)
      WRITE (6,1504) GASPRD(M1), GASPRD(M2), GASPRD(M3), GASPRD(M4)
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      WRITE (6,1505) REVNUE(M1), REVNUE(M2), REVNUE(M3), REVNUE(M4)
      WRITE (6,1506) ROYLTY(M1), ROYLTY(M2), ROYLTY(M3), ROYLTY(M4)
      WRITE (6,1507) GROSS(M1), GROSS(M2), GROSS(M3), GROSS(M4)
      WRITE (6,1508) OPCOST(M1), OPCOST(M2), OPCOST(M3), OPCOST(M4)
      WRITE (6,1509) DEPREC(M1), DEPREC(M2), DEPREC(M3), DEPREC(M4)
      WRITE (6,1510) DEPLET(M1), DEPLET(M2), DEPLET(M3), DEPLET(M4)
      WRITE (6,1511) BTXNET(M1), BTXNET(M2), BTXNET(M3), BTXNET(M4)
      WRITE (6,1512) NWELLS(M1), NWELLS(M2), NWELLS(M3), NWELLS(M4)
  622 CONTINUE
      WRITE (6,1)
      WRITE (6,1600) I, MONTH, NYEAR
      WRITE (6,2)
      WRITE (6,1601)
      WRITE (6,1602) TOTREV
      WRITE (6,1603) TOTREV, CASH(I)
      WRITE (6,1604) ACCREC(I)
      WRITE (6,1605) TOTTAN
      WRITE (6,1607) TOTRYL, TOTINT
      WRITE (6,1608) DELAYR, INVEST(I)
      WRITE (6,1609) DRILL, ASSETS(I)
      WRITE (6,1610) TOTOPC
      WRITE (6,1611) TOTDPR
      WRITE (6,1612) TOTDPL
      WRITE (6,1613) ABDCOS(I), ACCPAY(I)
      WRITE (6,1614) TOTOPE, STLOAN(I)
      WRITE (6,1615) OPNET, BONDS(I)
      WRITE (6,1616) PAYCAP(I)
      WRITE (6,1617) RTEARN(I)
      WRITE (6,1618) CPGAIN, TOTLIB
      WRITE (6,1619) DIVREC
      WRITE (6,1620) TOTINC
      WRITE (6,1621) SHARES(I)
      WRITE (6,1622) MQUOTE(I), BOOK
      WRITE (6,1623) CPLOSS
      WRITE (6,1624) INTPAY
      WRITE (6,1625) ADMIN
      WRITE (6,1626) EANDD(I)
      WRITE (6,1627) OPRES(I), REQLNS(I), REQBND(I)
      WRITE (6,1628) OTHEXP, REQINV(I), EMERG
      WRITE (6,1629) TOTHRS, PAY(I)
      WRITE (6,1630) HOLD1, EMPBEN(I)
      WRITE (6,1631) GAINLT(I), STRIKE
      WRITE (6,1632) FEDTAX, XLNGTH
      WRITE (6,1633) STATAX, OWN
      WRITE (6,1634) TAXLTG, OILALW
      WRITE (6,1635) NETINC(I), GASALW
      WRITE (6,1641)
      WRITE (6,1636) PENLTY, SALE
      WRITE (6,1637) DIVDND(I), DIVPAY, PAYAVG
      IF (SOLDST(I).LT.0.0) GO TO 710
      WRITE (6,1638) SOLDST(I), SELL, BENAVG
      GO TO 711
  710 TEMP = ABS(SOLDST(I))
      SOLDST(I) = 0.0
      WRITE(6,1638) SOLDST(I), SELL, BENAVG
      WRITE(6,1639) TEMP, BISTOK
      GO TO 712
  711 TEMP = 0.0
      WRITE(6,1639) TEMP, BISTOK
  712 WRITE (6,1640) EQUITY
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      WRITE (6,1641)
      WRITE (6,1641)
      WRITE (6,1641)
      WRITE (6,1641)
      WRITE (6,1641)
      WRITE (6,1650)
      IF (PENSEL(I,2).LE.0.01) GO TO 721
      WRITE (6,1000) PENSEL(I,1), PENSEL(I,2)
  721 IF (PENRVT(I,2).LE.0.01) GO TO 722
      WRITE (6,1001) PENRVT(I,1), PENRVT(I,2)
  722 IF (PENABD(I,2).LE.0.01) GO TO 723
      WRITE (6,1002) PENABD(I,1), PENABD(I,2)
  723 IF (PENDEP(I,2).LE.0.01) GO TO 724
      WRITE (6,1003) PENDEP(I,1), PENDEP(I,2)
  724 NETINC(I) = NETINC(I)/XLNGTH
  601 CONTINUE
      MONTH = MONTH + 1
      IF (NDECKS.EQ.1) GO TO 725
      NDECKS = NDECKS - 1
      GO TO 115
  725 WRITE(7,8) DRY, OIL, NDECKS
      WRITE(7,12) MONTH,NYEAR,LENGTH,MESES,NCOPYS,NPLAY,MAXOWN,LASTNM
      WRITE(7,11) FINE,OPRICE,GPRICE,ABDNFT,FTAXR,STAXR,STKFAC,VARCOS
      WRITE(7,11) RATEBD,BENFIT,BENBAS,RLABOR,PAYBAS,DIVBAS,ORBASE,
     1 RATEST
      WRITE(7,11) RNUM,ROYL,TERMSR,TERMSP,DVRATE,DRTANG,DRINTG,FRCCOS
      WRITE(7,11) OILALW,GASALW,DRYHCS,CASHFT,QUOTFT,FRCFAC, ACDFAC,
     1 EQCSFT
      WRITE(7,11) PMPCOS,ACDCOS,SECCOS,FRFLOW,ACFLOW,PMFLOW,SRFLOW,DECLN
      DO 811 I = 1,NPLAY
      WRITE(7,13) CASH(I),ASSETS(I),ACCREC(I),ACCPAY(I),INVEST(I),
     1 STLOAN(I),BONDS(I),MQUOTE(I)
      WRITE(7,13) PAYCAP(I),RTEARN(I),SHARES(I),ORCARY(I),OTHLOS(I),
     1 PAY(I), NETINC(I), EMPBEN(I)
  811 CONTINUE
      WRITE(7,16)((LESSEE(I,K), K=1,20), I=1,NPLAY)
      WRITE(7,18) LEASE
      WRITE(7,18) NWELLS
      WRITE(7,18) NPDATE
      WRITE(7,25) RESORS
      WRITE(7,27) EQLIFE
      WRITE(7,27) EQAGE
      WRITE(7,25) TANG
      WRITE(7,25) INTANG
      WRITE(7,18) IELECT
      WRITE(7,16) VCFACT
      WRITE(7,25) ACRES
      WRITE(7,16) GEOFAC
      WRITE(7,11) LESFAC
      WRITE(7,11) TIME
      WRITE(7,11) QZERO
      WRITE(7,29) DZERO
      WRITE(7,18) NO
      WRITE(7,25) BIDMIN
      WRITE(7,9) (WELNUM(I,1), I=1,1000)
      WRITE(7,16) (WELNUM(I,2), I=1,1000)
      WRITE(7,25) EQCOST
      WRITE(7,25) PINT
      WRITE(7,11) VISCTY
      WRITE(7,16) FVF
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      WRITE (7,25) GORINT                                               PDT1012
      JUMP = 1                                                          PDT1013
      GO TO 101                                                         PDT1014
C                                                                       PDT1015
 1000 FORMAT (1X,32HYOU HAVE ATTEMPTED TO SELL LEASE,F4.0,82HAN MAYBE OTPDT1016
     1HERS WHICH YOU DO NOT OWN.  YOU HAVE BEEN PENALIZED A TOTAL AMOUNTPDT1017
     2 OF $,F9.2/17H FOR THIS ACTION./)                                 PDT1018
 1001 FORMAT (1X,34HYOU HAVE ATTEMPTED TO REVERT LEASE,F4.0,1X,77HAN MAYPDT1019
     1BE OTHERS WHICH YOU DO NOT OWN.  YOU HAVE BEEN PENALIZED A TOTAL APDT1020
     2MOUNT/5H OF $,F9.2,17H FOR THIS ACTION./)                         PDT1021
 1002 FORMAT (1X,35HYOU HAVE ATTEMPTED TO ABANDON LEASE,F4.0,1X,77HAN MAPDT1022
     1YBE OTHERS WHICH YOU DO NOT OWN.  YOU HAVE BEEN PENALIZED A TOTAL PDT1023
     2AMOUNT/5H OF $,F9.2,17H FOR THIS ACTION./)                        PDT1024
 1003 FORMAT (1X,80HYOU HAVE ATTEMPTED TO MAKE AN UNAUTHORIZED CHANGE INPDT1025
     1 METHOD FOR COMPUTING DEPREC,10HIATION FOR,F4.0,18H AND MAYBE OTHEPDT1026
     2RS./23H  YOU HAVE BEEN FINED $,F10.0,16HFOR THIS ACTION.)         PDT1027
 1100 FORMAT (43X,43HLEASE DEVELOPMENT REPORT FOR COMPANY NUMBER,I4/)   PDT1028
 1101 FORMAT(/47X,32HDRILLING REPORT FOR LEASE NUMBER,I4//              PDT1029
     1 1X,5HMONTH,4X,12HWELL DRILLED,4X,6HSTATUS,4X,17HINITIAL FLOW RATEPDT1030
     2,4X,16HINITIAL PRESSURE,4X,18HPRODUCTIVITY INDEX,4X,9HVISCOSITY,4XPDT1031
     3,17HFORM. VOL. FACTOR)                                            PDT1032
 1103 FORMAT (1H ,I3,8X,I6,7X,A6,7X,F10.0)                              PDT1033
 1104 FORMAT (/46X,34HFRACTURING REPORT FOR LEASE NUMBER,I4/)           PDT1034
 1105 FORMAT (1X,21HTOTAL WELLS FRACTURED,F5.0,3X,18HAT A TOTAL COST OF,PDT1035
     1 F8.0/)                                                           PDT1036
 1106 FORMAT (/44X,37HACID TREATING REPORT FOR LEASE NUMBER,I4/)        PDT1037
 1107 FORMAT (1X,19HTOTAL WELLS TREATED,F5.0,3X,18HAT A TOTAL COST OF,  PDT1038
     1 F8.0/)                                                           PDT1039
 1109 FORMAT (1H ,I3,8X,I6,7X,A6,7X,F10.0,11X,F10.0,9X,F10.2,10X,F8.2,  PDT1040
     1 8X,F10.2)                                                        PDT1041
 1110 FORMAT (1X,48HONE WELL WAS FRACTURED AND TESTED AT A COST OF $,   PDT1042
     1 F10.0,59H.  THE FRACTURE TREATMENT DID NOT IMPROVE WELL PERFORMANPDT1043
     2CE./)                                                             PDT1044
 1111 FORMAT (1X,51HONE WELL WAS ACID TREATED AND TESTED AT A COST OF $,PDT1045
     1 F10.0,55H.  THE ACID TREATMENT DID NOT IMPROVE WELL PERFORMANCE.)PDT1046
 1112 FORMAT (/43X,40HPUMP INSTALLMENT REPORT FOR LEASE NUMBER,I4//     PDT1047
     1 1X,34HPUMPS WERE INSTALLED ON A TOTAL OF,F6.0,                   PDT1048
     2 27H WELLS AT A TOTAL COST OF $,F10.0)                            PDT1049
 1113 FORMAT (/1X,57HA SECONDARY RECOVERY SYSTEM WAS INSTALLED ON LEASE PDT1050
     1NUMBER,I4,21H AT A TOTAL COST OF $,F10.0)                         PDT1051
 1114 FORMAT (1H ,I3,8X,I6,7X,A6,7X,F10.0,11X,F10.0,9X,F10.2)           PDT1052
 1401 FORMAT (26X,79HTHIS IS A LIST OF LEASES BY NUMBER THAT ARE FOR SALPDT1053
     1E BY THE GAME ADMINISTRATOR.)                                     PDT1054
 1402 FORMAT (42X,I3,42X,I3)                                            PDT1055
 1501 FORMAT (23X,32HLEASE REPORTS FOR COMPANY NUMBER,I4,3X,            PDT1056
     1 28HFOR PERIOD ENDING WITH MONTH,I5,2X,8H OF YEAR,I4,1H./)        PDT1057
 1502 FORMAT (1H ,4(4X,12HLEASE NUMBER,I16))                            PDT1058
 1503 FORMAT (1H ,4(4X,19HOIL PRODUCED (BBLS),F9.0))                    PDT1059
 1504 FORMAT (1H ,4(4X,19HGAS PRODUCED (MSCF),F9.0))                    PDT1060
 1505 FORMAT (1H ,4(4X,18HREVENUE EARNED ($),F10.0))                    PDT1061
 1506 FORMAT (1H ,4(4X,18HROYALTIES PAID ($),F10.0))                    PDT1062
 1507 FORMAT (1H ,4(4X,16HGROSS INCOME ($),2X,F10.0))                   PDT1063
 1508 FORMAT (1H ,4(4X,19HOP + DRILL COST ($),F9.0))                    PDT1064
 1509 FORMAT (1H ,4(4X,16HDEPRECIATION ($),2X,F10.0))                   PDT1065
 1510 FORMAT (1H ,4(4X,13HDEPLETION ($),5X,F10.0))                      PDT1066
 1511 FORMAT (1H ,4(4X,18HNET BEFORE TAX ($),F10.0))                    PDT1067
 1512 FORMAT (1H ,4(4X,15HWELLS PRODUCING,3X,I10)/)                     PDT1068
 1600 FORMAT (19X,41HFINANCIAL STATUS SHEET FOR COMPANY NUMBER,I3,34H  FPDT1069
     1OR THE PERIOD ENDING WITH MONTH,I3,9H  OF YEAR,I3)                PDT1070
 1601 FORMAT (25X,16HINCOME STATEMENT,24X,1HI,27X,13HBALANCE SHEET/65X, PDT1071
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     1 1HI/25X,16HOPERATING INCOME,24X,1HI,30X,6HASSETS/65X,1HI)
1602 FORMAT (1X,40HREVENUE FROM SALE OF OIL AND NATURAL GAS,11X,1H$,
     1 F11.0,2H I)
1603 FORMAT (7X,22HTOTAL OPERATING INCOME,24X,F11.0,2H I,
     1           3X,12HCASH ON HAND,36X,1H$,F11.0)
1604 FORMAT (65X,1HI,
     1 3X,19HACCOUNTS RECEIVABLE,30X,F11.0)
1605 FORMAT (24X,18HOPERATING EXPENSES,23X,1HI,
     1 3X,18HTANGIBLE EQUIPMENT,31X,F11.0)
1607 FORMAT (1X,14HROYALTIES PAID,38X,F11.0,2H I,
     1 3X,35HINTANGIBLE LEASE INVESTMENT AT COST,14X,F11.0)
1608 FORMAT (1X,13HDELAY RENTALS,39X,F11.0,2H I,
     1           3X,19HOUTSIDE INVESTMENTS,30X,F11.0)
1609 FORMAT (1X,14HDRILLING COSTS,38X,F11.0,2H I,
     1 9X,12HTOTAL ASSETS,31X,F11.0)
1610 FORMAT (1X,15HOPERATING COSTS,37X,F11.0,2H I)
1611 FORMAT (1X,12HDEPRECIATION,40X,F11.0,2H I,
     1 28X,11HLIABILITIES)
1612 FORMAT (1X,9HDEPLETION,43X,F11.0,2H I)
1613 FORMAT (1X,17HABANDONMENT COSTS,35X,F11.0,2H I,
     1 3X,16HACCOUNTS PAYABLE,33X,F11.0)
1614 FORMAT (7X,24HTOTAL OPERATING EXPENSES,22X,F11.0,2H I,
     1 3X,16HSHORT TERM LOANS,33X,F11.0)
1615 FORMAT (1X,20HNET OPERATING INCOME,31X,1H$,F11.0,2H I,
     1 3X,5HBONDS,44X,F11.0)
1616 FORMAT (65X,1HI,
     1 3X,15HPAID IN CAPITAL,34X,F11.0)
1617 FORMAT (27X,12HOTHER INCOME,26X,1HI,
     1 3X,17HRETAINED EARNINGS,32X,F11.0)
1618 FORMAT (1X,13HCAPITAL GAINS,39X,F11.0,2H I,
     1 9X,17HTOTAL LIABILITIES,26X,F11.0)
1619 FORMAT (1X,18HDIVIDENDS RECEIVED,34X,F11.0,2H I)
1620 FORMAT (7X,18HTOTAL OTHER INCOME,28X,F11.0,2H I)
1621 FORMAT (65X,1HI,
     1           3X,34HSHARES OF COMMON STOCK OUTSTANDING,2X,F10.0)
1622 FORMAT (26X,14HOTHER EXPENSES,25X,1HI,
     1 3X,14HMARKET QUOTE $,F8.2,6X,10HBOOK VALUE,2X,1H$,F8.2)
1623 FORMAT (1X,14HCAPITAL LOSSES,37X,1H$,F11.0,2H I)
1624 FORMAT (1X,13HINTEREST PAID,39X,F11.0,2H I)
1625 FORMAT (1X,23HADMINISTRATIVE OVERHEAD,29X,F11.0,2H I,
     1 21X,25HDECISIONS AND ENVIRONMENT)
1626 FORMAT (1X,27HEXPLORATION AND DEVELOPMENT,25X,F11.0,2H I)
1627 FORMAT (1X,19HOPERATIONS RESEARCH,33X,F11.0,2H I,
     13X,16HSHORT TERM LOANS,5X,1H$,F10.0,2X,5HBONDS,10X,1H$,F10.0)
1628 FORMAT (7X,20HTOTAL OTHER EXPENSES,26X,F11.0,2H I,
     13X,16HINVESTMENTS MADE,6X,F10.0,2X,16HEMERGENCY LOANS$,F10.0)
1629 FORMAT (65X,1HI,
     1 3X,22HLABOR UTILIZED (HOURS),1X,F9.2,2X,16HLABOR RATE/HR. $,
     2 F10.2)
1630 FORMAT (1X,25HLESS  DIVIDEND DEDUCTIONS,27X,F11.0,2H I,
     1 3X,20HFRINGE BENEFITS/HOUR,2X,F10.2)
1631 FORMAT (7X,14HLONG TERM GAIN,32X,F11.0,2H I,3X,21HPROBABILITY OF S
     1TRIKE,1X,F10.2)
1632 FORMAT (1X,11HFEDERAL TAX,41X,F11.0,2H I,
     1 3X,22HPERIOD LENGTH (MONTHS),2X,F8.0)
1633 FORMAT (1X,9HSTATE TAX,43X,F11.0,2H I,
     1 3X,22HNUMBER OF LEASES OWNED,2X,F8.0)
1634 FORMAT (1X,22HTAX ON LONG TERM GAINS,30X,F11.0,2H I,
     1 3X,24HOIL ALLOWABLE BBLS/MONTH,F8.0)
1635 FORMAT (7X,10HNET INCOME,36X,F11.0,2H I,
```

```
   1 3X,24HGAS ALLOWABLE MSCF/MONTH,F8.0)
1636 FORMAT (1X,19HPENALTIES AND FINES,32X,1H$,F11.0,2H I,
   1 3X,35HNUMBER OF LEASES AVAILABLE FOR SALE,15X,F10.0)
1637 FORMAT (1X,18HDIVIDEND PER SHARE,1X,1H$,F10.2,4X,15HAMOUNT PAID OU
   1T,3X,F11.0,2H I,
   2 3X,26HAVERAGE INDUSTRY WAGE RATE,22X,1H$,F11.2)
1638 FORMAT (1X,17HCOMMON STOCK SOLD,3X,F10.0,4X,15HAMOUNT RECEIVED,3X,
   1 F11.0,2H I,
   2 3X,36HAVERAGE INDUSTRY FRINGE BENEFIT RATE,13X,F11.2)
1639 FORMAT (1X,15HSTOCK PURCHASED,5X,F10.0,4X,15HAMOUNT PAID OUT,3X,
   1 F11.0,2H I)
1640 FORMAT (1X,31HCHANGE IN STOCKHOLDERS- EQUITY,21X,F11.0,2H I)
1641 FORMAT (65X,1HI)
1650 FORMAT (65(2H -)/62X,7HREMARKS/)
 999 CALL EXIT
     END
```

```
      SUBROUTINE RANDNO (RNUM)
      I = RNUM * 10.0
    1 CONTINUE
      RNUM = (RNUM * 100. + 3.)**2
      X = RNUM * .001
      M = X
      Y = M
      RNUM = X - Y
      J = RNUM * 10.0
      IF (I.EQ.J) GO TO 1
      RETURN
      END
```

# APPENDIX C
Program Output

LEASE DEVELOPMENT REPORT FOR COMPANY NUMBER 3

FRACTURING REPORT FOR LEASE NUMBER 5

ONE WELL WAS FRACTURED AND TESTED AT A COST OF $ 4000.. THE FRACTURE TREATMENT DID NOT IMPROVE WELL PERFORMANCE.

DRILLING REPORT FOR LEASE NUMBER 17

| MONTH | WELL DRILLED | STATUS | INITIAL FLOW RATE | INITIAL PRESSURE | PRODUCTIVITY INDEX | VISCOSITY | FORM. VOL. FACTOR |
|---|---|---|---|---|---|---|---|
| 1 | 1 | OIL | 94. | 1327. | 0.05 | 1.99 | 1.13 |
| 2 | 1 | OIL | 666. | 1327. | 0.36 | | |
| 2 | 2 | OIL | 285. | 1327. | 0.15 | | |
| 2 | 3 | OIL | 508. | 1327. | 0.28 | | |
| 2 | 4 | OIL | 542. | 1327. | 0.29 | | |
| 3 | 1 | DRY | 0. | | | | |

DRILLING REPORT FOR LEASE NUMBER 24

| MONTH | WELL DRILLED | STATUS | INITIAL FLOW RATE | INITIAL PRESSURE | PRODUCTIVITY INDEX | VISCOSITY | FORM. VOL. FACTOR |
|---|---|---|---|---|---|---|---|
| 1 | 1 | DRY | 0. | | | | |

DRILLING REPORT FOR LEASE NUMBER 32

| MONTH | WELL DRILLED | STATUS | INITIAL FLOW RATE | INITIAL PRESSURE | PRODUCTIVITY INDEX | VISCOSITY | FORM. VOL. FACTOR |
|---|---|---|---|---|---|---|---|
| 1 | 1 | OIL | 1942. | 1910. | 0.73 | 11.39 | 1.19 |
| 2 | 1 | OIL | 1700. | 1910. | 0.64 | | |
| 2 | 2 | OIL | 2116. | 1910. | 0.80 | | |
| 2 | 3 | OIL | 1919. | 1910. | 0.72 | | |
| 2 | 4 | OIL | 339. | 1910. | 0.13 | | |
| 3 | 1 | OIL | 623. | 1910. | 0.23 | | |
| 3 | 2 | OIL | 1723. | 1910. | 0.65 | | |
| 3 | 3 | OIL | 2400. | 1910. | 0.90 | | |
| 3 | 4 | OIL | 596. | 1910. | 0.22 | | |

DRILLING REPORT FOR LEASE NUMBER 42

| MONTH | WELL DRILLED | STATUS | INITIAL FLOW RATE | INITIAL PRESSURE | PRODUCTIVITY INDEX | VISCOSITY | FORM. VOL. FACTOR |
|---|---|---|---|---|---|---|---|
| 1 | 1 | DRY | 0. | | | | |

DRILLING REPORT FOR LEASE NUMBER 52

| MONTH | WELL DRILLED | STATUS | INITIAL FLOW RATE | INITIAL PRESSURE | PRODUCTIVITY INDEX | VISCOSITY | FORM. VOL. FACTOR |
|---|---|---|---|---|---|---|---|
| 1 | 1 | DRY | 0. | | | | |

(This is a sample Lease Development Report. The first part of the report shows that an attempt was made to fracture the wells on lease number 5, but the attempt was unsuccessful. It also shows that three dry holes were drilled on leases 24, 42, and 52, and that the initial drilling on lease number 17 was a discovery well. The last well drilled on lease number 17 was a dry hole which indicates that the limit of the number of wells for that lease has been reached. Finally, it shows the initial drilling and some of the development wells for lease number 32.)

LEASE DEVELOPMENT REPORT FOR COMPANY NUMBER 3

DRILLING REPORT FOR LEASE NUMBER 5

| MONTH | WELL DRILLED | STATUS | INITIAL FLOW RATE | INITIAL PRESSURE | PRODUCTIVITY INDEX | VISCOSITY | FORM. VOL. FACTOR |
|---|---|---|---|---|---|---|---|
| 1 | 1 | OIL | 161. | 4213. | 0.03 | | |
| 1 | 2 | OIL | 307. | 4213. | 0.05 | | |
| 1 | 3 | OIL | 1314. | 4213. | 0.22 | | |
| 1 | 4 | OIL | 639. | 4213. | 0.14 | | |
| 2 | 1 | OIL | 3. | 4213. | 0.00 | | |
| 2 | 2 | OIL | 327. | 4213. | 0.06 | | |
| 2 | 3 | OIL | 598. | 4213. | 0.10 | | |
| 2 | 4 | OIL | 1559. | 4213. | 0.27 | | |

DRILLING REPORT FOR LEASE NUMBER 17

| MONTH | WELL DRILLED | STATUS | INITIAL FLOW RATE | INITIAL PRESSURE | PRODUCTIVITY INDEX | VISCOSITY | FORM. VOL. FACTOR |
|---|---|---|---|---|---|---|---|
| 1 | 1 | DRY | 0. | | | | |

DRILLING REPORT FOR LEASE NUMBER 32

| MONTH | WELL DRILLED | STATUS | INITIAL FLOW RATE | INITIAL PRESSURE | PRODUCTIVITY INDEX | VISCOSITY | FORM. VOL. FACTOR |
|---|---|---|---|---|---|---|---|
| 1 | 1 | OIL | 1025. | 1910. | 0.39 | | |
| 1 | 2 | OIL | 1293. | 1910. | 0.49 | | |
| 1 | 3 | OIL | 639. | 1910. | 0.24 | | |
| 1 | 4 | OIL | 1801. | 1910. | 0.68 | | |
| 2 | 1 | OIL | 453. | 1910. | 0.17 | | |
| 2 | 2 | OIL | 998. | 1910. | 0.38 | | |
| 2 | 3 | OIL | 1798. | 1910. | 0.68 | | |
| 2 | 4 | OIL | 414. | 1910. | 0.16 | | |

(This is another sample Lease Development Report six months later in simulated time than the previous sample lease report. The company drilled 8 development wells each on leases 5 and 32. The company also attempted to further develop ent lease number 17 even though a dry hole was previously drilled. This attempt resulted in a dry hole also.)

THIS IS A LIST OF LEASES BY NUMBER THAT ARE FOR SALE BY THE GAME ADMINISTRATOR.

| | |
|---|---|
| 0 | 29 |
| 2 | 0 |
| 3 | 31 |
| 4 | 0 |
| 0 | 33 |
| 6 | 34 |
| 7 | 0 |
| 0 | 0 |
| 9 | 37 |
| 0 | 0 |
| 11 | 39 |
| 0 | 0 |
| 13 | 41 |
| 14 | 42 |
| 15 | 0 |
| 16 | 44 |
| 0 | 0 |
| 18 | 46 |
| 19 | 47 |
| 20 | 0 |
| 21 | 0 |
| 0 | 50 |
| 23 | 0 |
| 24 | 52 |
| 0 | 0 |
| 26 | 0 |
| 27 | 0 |
| 28 | 0 |

LEASE REPORTS FOR COMPANY NUMBER 3 FOR PERIOD ENDING WITH MONTH 6 OF YEAR 2.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| LEASE NUMBER | 5 | LEASE NUMBER | 0 | LEASE NUMBER | 0 | LEASE NUMBER | 0 |
| OIL PRODUCED (BBLS) | 117000. | OIL PRODUCED (BBLS) | 0. | OIL PRODUCED (BBLS) | 0. | OIL PRODUCED (BBLS) | 0. |
| GAS PRODUCED (MSCF) | 97557. | GAS PRODUCED (MSCF) | 0. | GAS PRODUCED (MSCF) | 0. | GAS PRODUCED (MSCF) | 0. |
| REVENUE EARNED ($) | 384159. | REVENUE EARNED ($) | 0. | REVENUE EARNED ($) | 0. | REVENUE EARNED ($) | 0. |
| ROYALTIES PAID ($) | 49941. | ROYALTIES PAID ($) | 0. | ROYALTIES PAID ($) | 0. | ROYALTIES PAID ($) | 0. |
| GROSS INCOME ($) | 334218. | GROSS INCOME ($) | 0. | GROSS INCOME ($) | 0. | GROSS INCOME ($) | 0. |
| OP + DRILL COST ($) | 135740. | OP + DRILL COST ($) | 0. | OP + DRILL COST ($) | 0. | OP + DRILL COST ($) | 0. |
| DEPRECIATION ($) | 8400. | DEPRECIATION ($) | 0. | DEPRECIATION ($) | 0. | DEPRECIATION ($) | 0. |
| DEPLETION ($) | 91910. | DEPLETION ($) | 0. | DEPLETION ($) | 0. | DEPLETION ($) | 0. |
| NET BEFORE TAX ($) | 93129. | NET BEFORE TAX ($) | 0. | NET BEFORE TAX ($) | 0. | NET BEFORE TAX ($) | 0. |
| WELLS PRODUCING | 15 | WELLS PRODUCING | -0 | WELLS PRODUCING | -0 | WELLS PRODUCING | -0 |
| LEASE NUMBER | 17 | LEASE NUMBER | 0 | LEASE NUMBER | 32 | LEASE NUMBER | 0 |
| OIL PRODUCED (BBLS) | 45000. | OIL PRODUCED (BBLS) | 0. | OIL PRODUCED (BBLS) | 135000. | OIL PRODUCED (BBLS) | 0. |
| GAS PRODUCED (MSCF) | 34110. | GAS PRODUCED (MSCF) | 0. | GAS PRODUCED (MSCF) | 114474. | GAS PRODUCED (MSCF) | 0. |
| REVENUE EARNED ($) | 147208. | REVENUE EARNED ($) | 0. | REVENUE EARNED ($) | 443566. | REVENUE EARNED ($) | 0. |
| ROYALTIES PAID ($) | 19137. | ROYALTIES PAID ($) | 0. | ROYALTIES PAID ($) | 57664. | ROYALTIES PAID ($) | 0. |
| GROSS INCOME ($) | 128071. | GROSS INCOME ($) | 0. | GROSS INCOME ($) | 385902. | GROSS INCOME ($) | 0. |
| OP + DRILL COST ($) | 14802. | OP + DRILL COST ($) | 0. | OP + DRILL COST ($) | 140789. | OP + DRILL COST ($) | 0. |
| DEPRECIATION ($) | 2800. | DEPRECIATION ($) | 0. | DEPRECIATION ($) | 9520. | DEPRECIATION ($) | 0. |
| DEPLETION ($) | 35219. | DEPLETION ($) | 0. | DEPLETION ($) | 106123. | DEPLETION ($) | 0. |
| NET BEFORE TAX ($) | 75249. | NET BEFORE TAX ($) | 0. | NET BEFORE TAX ($) | 129470. | NET BEFORE TAX ($) | 0. |
| WELLS PRODUCING | 5 | WELLS PRODUCING | -0 | WELLS PRODUCING | 17 | WELLS PRODUCING | -0 |
| LEASE NUMBER | 0 | LEASE NUMBER | -0 | LEASE NUMBER | -0 | LEASE NUMBER | -0 |
| OIL PRODUCED (BBLS) | 0. | OIL PRODUCED (BBLS) | 0. | OIL PRODUCED (BBLS) | 0. | OIL PRODUCED (BBLS) | 0. |
| GAS PRODUCED (MSCF) | 0. | GAS PRODUCED (MSCF) | 0. | GAS PRODUCED (MSCF) | 0. | GAS PRODUCED (MSCF) | 0. |
| REVENUE EARNED ($) | 0. | REVENUE EARNED ($) | 0. | REVENUE EARNED ($) | 0. | REVENUE EARNED ($) | 0. |
| ROYALTIES PAID ($) | 0. | ROYALTIES PAID ($) | 0. | ROYALTIES PAID ($) | 0. | ROYALTIES PAID ($) | 0. |
| GROSS INCOME ($) | 0. | GROSS INCOME ($) | 0. | GROSS INCOME ($) | 0. | GROSS INCOME ($) | 0. |
| OP + DRILL COST ($) | 0. | OP + DRILL COST ($) | 0. | OP + DRILL COST ($) | 0. | OP + DRILL COST ($) | 0. |
| DEPRECIATION ($) | 0. | DEPRECIATION ($) | 0. | DEPRECIATION ($) | 0. | DEPRECIATION ($) | 0. |
| DEPLETION ($) | 0. | DEPLETION ($) | 0. | DEPLETION ($) | 0. | DEPLETION ($) | 0. |
| NET BEFORE TAX ($) | 0. | NET BEFORE TAX ($) | 0. | NET BEFORE TAX ($) | 0. | NET BEFORE TAX ($) | 0. |
| WELLS PRODUCING | -0 | WELLS PRODUCING | -0 | WELLS PRODUCING | -0 | WELLS PRODUCING | -0 |
| LEASE NUMBER | -0 | LEASE NUMBER | -0 | LEASE NUMBER | -0 | LEASE NUMBER | -0 |
| OIL PRODUCED (BBLS) | 0. | OIL PRODUCED (BBLS) | 0. | OIL PRODUCED (BBLS) | 0. | OIL PRODUCED (BBLS) | 0. |
| GAS PRODUCED (MSCF) | 0. | GAS PRODUCED (MSCF) | 0. | GAS PRODUCED (MSCF) | 0. | GAS PRODUCED (MSCF) | 0. |
| REVENUE EARNED ($) | 0. | REVENUE EARNED ($) | 0. | REVENUE EARNED ($) | 0. | REVENUE EARNED ($) | 0. |
| ROYALTIES PAID ($) | 0. | ROYALTIES PAID ($) | 0. | ROYALTIES PAID ($) | 0. | ROYALTIES PAID ($) | 0. |
| GROSS INCOME ($) | 0. | GROSS INCOME ($) | 0. | GROSS INCOME ($) | 0. | GROSS INCOME ($) | 0. |
| OP + DRILL COST ($) | 0. | OP + DRILL COST ($) | 0. | OP + DRILL COST ($) | 0. | OP + DRILL COST ($) | 0. |
| DEPRECIATION ($) | 0. | DEPRECIATION ($) | 0. | DEPRECIATION ($) | 0. | DEPRECIATION ($) | 0. |
| DEPLETION ($) | 0. | DEPLETION ($) | 0. | DEPLETION ($) | 0. | DEPLETION ($) | 0. |
| NET BEFORE TAX ($) | 0. | NET BEFORE TAX ($) | 0. | NET BEFORE TAX ($) | 0. | NET BEFORE TAX ($) | 0. |
| WELLS PRODUCING | -0 | WELLS PRODUCING | -0 | WELLS PRODUCING | -0 | WELLS PRODUCING | -0 |
| LEASE NUMBER | -0 | LEASE NUMBER | -0 | LEASE NUMBER | -0 | LEASE NUMBER | -0 |
| OIL PRODUCED (BBLS) | 0. | OIL PRODUCED (BBLS) | 0. | OIL PRODUCED (BBLS) | 0. | OIL PRODUCED (BBLS) | 0. |
| GAS PRODUCED (MSCF) | 0. | GAS PRODUCED (MSCF) | 0. | GAS PRODUCED (MSCF) | 0. | GAS PRODUCED (MSCF) | 0. |
| REVENUE EARNED ($) | 0. | REVENUE EARNED ($) | 0. | REVENUE EARNED ($) | 0. | REVENUE EARNED ($) | 0. |
| ROYALTIES PAID ($) | 0. | ROYALTIES PAID ($) | 0. | ROYALTIES PAID ($) | 0. | ROYALTIES PAID ($) | 0. |
| GROSS INCOME ($) | 0. | GROSS INCOME ($) | 0. | GROSS INCOME ($) | 0. | GROSS INCOME ($) | 0. |
| OP + DRILL COST ($) | 0. | OP + DRILL COST ($) | 0. | OP + DRILL COST ($) | 0. | OP + DRILL COST ($) | 0. |
| DEPRECIATION ($) | 0. | DEPRECIATION ($) | 0. | DEPRECIATION ($) | 0. | DEPRECIATION ($) | 0. |
| DEPLETION ($) | 0. | DEPLETION ($) | 0. | DEPLETION ($) | 0. | DEPLETION ($) | 0. |
| NET BEFORE TAX ($) | 0. | NET BEFORE TAX ($) | 0. | NET BEFORE TAX ($) | 0. | NET BEFORE TAX ($) | 0. |
| WELLS PRODUCING | -0 | WELLS PRODUCING | -0 | WELLS PRODUCING | -0 | WELLS PRODUCING | -0 |

(This is a sample of the lease reports for Company number 3.)

FINANCIAL STATUS SHEET FOR COMPANY NUMBER 3 FOR THE PERIOD ENDING WITH MONTH 6 OF YEAR 2

| INCOME STATEMENT | | | | |
|---|---|---|---|---|
| **OPERATING INCOME** | | | | |
| REVENUE FROM SALE OF OIL AND NATURAL GAS | | | $ | 974932. |
| TOTAL OPERATING INCOME | | | | 974932. |
| **OPERATING EXPENSES** | | | | |
| ROYALTIES PAID | | | | 124741. |
| DELAY RENTALS | | | | 0. |
| DRILLING COSTS | | | | 192000. |
| OPERATING COSTS | | | | 99371. |
| DEPRECIATION | | | | 20720. |
| DEPLETION | | | | 234253. |
| ABANDONMENT COSTS | | | | 0. |
| TOTAL OPERATING EXPENSES | | | | 672084. |
| NET OPERATING INCOME | | | $ | 302848. |
| **OTHER INCOME** | | | | |
| CAPITAL GAINS | | | | 0. |
| DIVIDENDS RECEIVED | | | | -0. |
| TOTAL OTHER INCOME | | | | -0. |
| **OTHER EXPENSES** | | | | |
| CAPITAL LOSSES | | | $ | 254337. |
| INTEREST PAID | | | | -0. |
| ADMINISTRATIVE OVERHEAD | | | | 42973. |
| EXPLORATION AND DEVELOPMENT | | | | 13000. |
| OPERATIONS RESEARCH | | | | 200000. |
| TOTAL OTHER EXPENSES | | | | 510310. |
| LESS DIVIDEND DEDUCTIONS | | | | -0. |
| LONG TERM GAIN | | | | 0. |
| FEDERAL TAX | | | | 0. |
| STATE TAX | | | | 25446. |
| TAX ON LONG TERM GAINS | | | | 0. |
| NET INCOME | | | | 205422. |
| PENALTIES AND FINES | | | $ | 0. |
| DIVIDEND PER SHARE $ | 2.00 | AMOUNT PAID OUT | | 200000. |
| COMMON STOCK SOLD | -0. | AMOUNT RECEIVED | | 0. |
| STOCK PURCHASED | 0. | AMOUNT PAID OUT | | 0. |
| CHANGE IN STOCKHOLDERS' EQUITY. | | | | 5422. |

| BALANCE SHEET | | | | |
|---|---|---|---|---|
| **ASSETS** | | | | |
| CASH ON HAND | | | $ | 1404286. |
| ACCOUNTS RECEIVABLE | | | | 487466. |
| TANGIBLE EQUIPMENT | | | | 229950. |
| INTANGIBLE LEASE INVESTMENT AT COST | | | | 0. |
| OUTSIDE INVESTMENTS | | | | 200000. |
| TOTAL ASSETS | | | | 2321702. |
| **LIABILITIES** | | | | |
| ACCOUNTS PAYABLE | | | | 158500. |
| SHORT TERM LOANS | | | | -0. |
| BONDS | | | | 190155. |
| PAID IN CAPITAL | | | | 1500000. |
| RETAINED EARNINGS | | | | 473046. |
| TOTAL LIABILITIES | | | | 2321701. |
| SHARES OF COMMON STOCK OUTSTANDING | 100000. | | | |
| MARKET QUOTE $ 25.34 | | BOOK VALUE | $ | 19.73 |
| **DECISIONS AND ENVIRONMENT** | | | | |
| SHORT TERM LOANS $ | -0. | BONDS | $ | -0. |
| INVESTMENTS MADE | 200000. | EMERGENCY LOANS | $ | 0. |
| LABOR UTILIZED (HOURS) | 370.00 | LABOR RATE/HR. | $ | 3.00 |
| FRINGE BENEFITS/HOUR | 0.20 | | | |
| PROBABILITY OF STRIKE | 0.00 | | | |
| PERIOD LENGTH (MONTHS) | 6. | | | |
| NUMBER OF LEASES OWNED | 3. | | | |
| OIL ALLOWABLE BBLS/MONTH | 1500. | | | |
| GAS ALLOWABLE MSCF/MONTH | 8000. | | | |
| NUMBER OF LEASES AVAILABLE FOR SALE | | | | 33. |
| AVERAGE INDUSTRY WAGE RATE | | | $ | 3.00 |
| AVERAGE INDUSTRY FRINGE BENEFIT RATE | | | | 0.20 |

REMARKS

(This is a sample of the Financial Status Sheet for Company number 3.)

# APPENDIX D

Listing of the Carryover and Decision Decks

SAMPLE CARRYOVER DECK FOR PAYDIRT

```
DRY     OIL      1
         13           1           6        12           1           5          20         149
  5000.00        3.15        0.16   2000.00        0.48        0.03        0.50        0.30
     0.00        0.20        0.20      3.00        3.00        4.00   200000.00        0.00
     0.49        0.13        3.00      3.00        0.20     7000.00    12000.00     4000.00   PARAMETERS
  1500.00     8000.00    13000.00      0.50        0.60        0.15        0.15        0.40
  8000.00     2000.00    10000.00      1.25        1.15        1.20        1.25        1.10
 1730262.    1955177.      24148.   250000.         -0.         -0.     195031.       14.40
 1500000.      10146.     100000.       -0.     311854.          3.    -103951.        0.20
 1649562.    1926456.      41456.   240500.         -0.         -0.     195031.       14.40
 1500000.      -9065.     100000.       -0.     328540.          3.    -106767.        0.20
 1888930.    2148656.      71796.   186000.         -0.         -0.     195031.       14.40   COMPANY
 1500000.     267624.     100000.       -0.     224337.          3.     -70420.        0.20   FINANCIAL
 1670157.    1946874.      41444.   252500.         -0.         -0.     195031.       13.82   DATA
 1500000.       -657.     100000.       -0.     338140.          3.    -109967.        0.20
 1538207.    2105157.     102411.   507000.         -0.         -0.     195031.       14.40
 1500000.     -96874.     100000.       -0.     565175.          3.    -185645.        0.20
  0   0  13  20  26  29  36  49  53  56  -0  -0  -0  -0  -0  -0  -0  -0  -0  -0
  0   0  10   0   0   9  14  18  22  25  35  54  -0  -0  -0  -0  -0  -0  -0  -0
  5   0   0   0  17  24  32  42  52  -0  -0  -0  -0  -0  -0  -0  -0  -0  -0  -0   LESSEE
  0   0  38   7  31  41  45  50  55  51  -0  -0  -0  -0  -0  -0  -0  -0  -0  -0
  0  40   0   8  12  19  34  37  43  48  30  -0  -0  -0  -0  -0  -0  -0  -0  -0
  0   2   3   4   0   6   0   0   0   0  11   0   0   0  15  16   0   0   0   0
 21   0  23   0   0   0  27  28   0   0   0   0  33   0   0   0   0   0  39   0   LEASES
  0   0   0  44   0  46  47   0   0   0   0   0   0   0   0   0
 -0  -0  -0  -0   7  -0  -0   9  -0   7  -0   9  -0  -0  -0  -0   5  -0  -0  -0
 -0  -0  -0  -0   9  -0  -0  -0  -0  16  -0   9  -0  -0   9   9  -0   7  -0   7   NWELLS
 -0  -0   9  -0   9  -0  -0   9  -0  -0   9  -0  -0  -0  -0   9
 -0   1   1  -0   1   1  10  10  10   1   1  10  10  10   1  -0  10  10  10  10
 -0  10   1  10  10  10  -0  -0  10  10  10  10   1  10  10  10  10   1   1   1   NPDATE
 10  10  10   1  10   1   1  10  10  10  10  10  10  10  10  10
      -0.         -0.         -0.       -0.    1621026.         -0.         -0.     960451.
      -0.     745965.         -0.  1487850.         -0.         -0.         -0.         -0.
  101318.         -0.         -0.       -0.         -0.         -0.         -0.         -0.
 1426516.         -0.         -0.       -0.         -0.    1653489.         -0.    1456255.   RESORS
      -0.         -0.     937577.   786097.         -0.     534295.         -0.    1238071.
      -0.         -0.     918882.       -0.     323304.         -0.         -0.     310312.
      -0.         -0.    1485676.       -0.         -0.         -0.         -0.     753377.
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  3.  -0.  -0.  -0.  -0.  -0.   3.  -0.   3.  -0.  -0.  -0.  -0.   6.  -0.   3.   EQAGE
  3.  -0.   3.   3.  -0.   6.   3.   6.  -0.  -0.   3.   3.   3.   3.   3.   3.
 -0.  -0.   6.  -0.  -0.  -0.  -0.   3.
      -0.         -0.         -0.       -0.      44590.         -0.         -0.      60480.
      -0.      44590.         -0.    60480.         -0.         -0.         -0.         -0.
   33600.         -0.         -0.       -0.         -0.         -0.         -0.         -0.
   60480.         -0.         -0.       -0.         -0.     105070.         -0.      60480.   TANG
      -0.         -0.      60480.    60480.         -0.      44590.         -0.      44590.
      -0.         -0.      60480.       -0.      60480.         -0.         -0.      60480.
      -0.         -0.      60480.       -0.         -0.         -0.         -0.      60480.
      -0.          0.          0.       -0.          0.          0.      10000.       9923.
   10000.          0.          0.     9950.      10000.      10000.          0.         -0.
    9311.      10000.      10000.    10000.         -0.      10000.          0.      10000.   INTANG
    9948.      10000.         -0.       -0.      10000.       3404.      10000.       9949.
       0.      10000.       9921.     9905.      10000.          0.          0.          0.
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   10000.     10000.      9919.         0.      9773.         0.         0.      9764.
   10000.     10000.      9950.     10000.     10000.     10000.     10000.      9901.
 -0   -0   -0   -0    2   -0   -0    2   -0    2   -0    2   -0   -0   -0   -0    2   -0   -0   -0
 -0   -0   -0   -0    2   -0   -0   -0   -0    2   -0    2   -0   -0    2    2   -0    2   -0    2    IELECT
 -0   -0    2   -0    2   -0   -0    2   -0   -0    2   -0   -0   -0   -0    2
0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30 0.30
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    2000.      2000.      2000.      2000.      2000.      2000.      2000.      2000.
    2000.      2000.      2000.      2000.      2000.      2000.      2000.      2000.      ACRES
    2000.      2000.      2000.      2000.      2000.      2000.      2000.      2000.
    2000.      2000.      2000.      2000.      2000.      2000.      2000.      2000.
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0.00 0.00 0.00 0.00 0.20 0.00 0.20 0.00 0.20 0.00 0.20 0.20 0.00 0.20 0.00 0.20
0.20 0.00 0.20 0.20 0.00 0.20 0.20 0.20 0.00 0.00 0.20 0.20 0.20 0.20 0.20 0.20      GEOFAC
0.00 0.00 0.20 0.00 0.00 0.00 0.00 0.20
    -0.00       0.00       0.00      -0.00       7.32       0.00      -0.00       4.57
    -0.00       4.91       0.00       2.68      -0.00      -0.00       0.00      -0.00
    -0.00      -0.00      -0.00      -0.00      -0.00      -0.00       0.00      -0.00
     5.19      -0.00      -0.00      -0.00      -0.00       3.31      -0.00       4.23      LESFAC
     0.00      -0.00       4.29       3.47      -0.00       3.69       0.00       4.12
    -0.00      -0.00       5.42       0.00       0.65       0.00       0.00       1.30
    -0.00      -0.00       4.95      -0.00      -0.00      -0.00      -0.00       3.00
    -0.00      -0.00      -0.00      -0.00       2.25      -0.00      -0.00       0.17
    -0.00       2.35      -0.00       0.04      -0.00      -0.00      -0.00      -0.00
     0.66      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
     0.07      -0.00      -0.00      -0.00      -0.00       2.32      -0.00       0.06      TIME
    -0.00      -0.00       0.09       0.12      -0.00       2.43      -0.00       2.26
    -0.00      -0.00       0.14      -0.00       0.14      -0.00      -0.00       0.61
    -0.00      -0.00       0.05      -0.00      -0.00      -0.00      -0.00       1.08
    -0.00      -0.00      -0.00      -0.00    2931.32      -0.00      -0.00    2000.73
    -0.00    2000.73      -0.00    2931.32      -0.00      -0.00      -0.00      -0.00
   752.45      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00      -0.00
  2931.32      -0.00      -0.00      -0.00      -0.00    2931.32      -0.00    2931.32      QZERO
    -0.00      -0.00    2000.73    2000.73      -0.00    1035.00      -0.00    2931.32
    -0.00      -0.00    2000.73      -0.00    1375.49      -0.00      -0.00    1375.49
    -0.00      -0.00    2931.32      -0.00      -0.00      -0.00      -0.00    2000.73
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 0.038333 -0.000000 -0.000000 -0.000000 -0.000000 -0.000000 -0.000000 -0.000000
 0.035000 -0.000000 -0.000000 -0.000000 -0.000000  0.035000 -0.000000  0.035000      DZERO
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 40   40   40   40   40   40   40   40   40   40   40   40   40   40   40   40   40   40   40   40
 40   40   40   40   40   40   40   40   40   40   40   40   40   40   40   40   40   30   40   40    NO
 40   40   40   40   40   40   40   40   40   40   40   40   40   40   40   40
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0.43 0.30 0.08 0.12 0.24 0.70 0.40 0.09 0.27 0.88 0.22 0.64 0.45 0.31 0.75 0.12
0.21 0.59 0.90 0.63 0.41 0.11 0.10 0.16 0.38 0.65 0.04 0.13 0.23 0.34 0.80 0.90
0.72 0.55 0.39 0.61 0.22 0.65 0.03 0.12 0.23 0.66 0.83 0.32 0.01 0.13 0.25 0.77
0.44 0.22 0.60 0.99 0.44 0.54 0.98 0.25 0.81 0.05 0.15 0.33 0.29 0.01 0.80 0.19
0.49 0.75 0.09 0.14 0.29 0.99 0.48 0.12 0.89 0.38 0.68 0.72 0.66 0.58 0.72 0.65
0.12 0.21 0.59 0.82 0.20 0.79 0.06 0.12 0.23 0.65 0.58 0.69 0.21 0.56 0.80 0.87
0.16 0.37 0.61 0.15 0.32 0.20 0.52 0.27 0.06 0.13 0.27 0.90 0.73 0.63 0.39 0.75
0.81 0.52 1.00 0.59 0.80 0.84 0.56 0.49 0.70 0.43 0.86 0.01 0.11 0.20 0.54 0.20
0.52 0.04 0.08 0.98 0.30 0.07 0.17 0.38 0.69 0.13 0.26 0.86 0.53 0.13 0.27 0.89
0.42 0.03 0.11 0.49-0.00-0.00-0.00-0.00-0.00-0.00-0.00-0.00-0.00-0.00-0.00-0.00
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WELNUM(I,1)

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-0.00-0.00-0.00-0.00-0.00-0.00-0.00-0.00-0.00-0.00-0.00-0.00-0.00-0.00-0.00-0.00
-0.00-0.00-0.00-0.00-0.00-0.00-0.00-0.00
```

WELNUM(I,2)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| -0. | -0. | -0. | -0. | 49000. | -0. | -0. | 63000. |
| -0. | 49000. | -0. | 63000. | -0. | -0. | -0. | -0. |
| 35000. | -0. | -0. | -0. | -0. | -0. | -0. | -0. |
| 63000. | -0. | -0. | -0. | -0. | 112000. | -0. | 63000. |
| -0. | -0. | 63000. | 63000. | -0. | 49000. | -0. | 49000. |
| -0. | -0. | 63000. | -0. | 63000. | -0. | -0. | 63000. |
| -0. | -0. | 63000. | -0. | -0. | -0. | -0. | 63000. |
| -0. | -0. | -0. | -0. | 4213. | -0. | -0. | 3493. |
| -0. | 3674. | -0. | 2018. | -0. | -0. | -0. | -0. |

EQCOST

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1327. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | PINT |
| 1807. | -0. | -0. | -0. | -0. | 4247. | -0. | 1910. | |
| -0. | -0. | 3345. | 2361. | -0. | 3500. | -0. | 4062. | |
| -0. | -0. | 3223. | -0. | 3650. | -0. | -0. | 3433. | |
| -0. | -0. | 2011. | -0. | -0. | -0. | -0. | 2149. | |
| -0.00 | -0.00 | -0.00 | -0.00 | 1.96 | -0.00 | -0.00 | 1.96 | VISCTY |
| -0.00 | 1.96 | -0.00 | 1.23 | -0.00 | -0.00 | -0.00 | -0.00 | |
| 1.99 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | -0.00 | |
| 4.40 | -0.00 | -0.00 | -0.00 | -0.00 | 0.53 | -0.00 | 11.39 | |
| -0.00 | -0.00 | 4.75 | 1.28 | -0.00 | 1.93 | -0.00 | 1.92 | |
| -0.00 | -0.00 | 2.65 | -0.00 | 2.86 | -0.00 | -0.00 | 1.91 | |
| -0.00 | -0.00 | 12.98 | -0.00 | -0.00 | -0.00 | -0.00 | 2.00 | |

FVF

```
-0.00-0.00-0.00-0.00 1.37-0.00-0.00 1.35-0.00 1.32-0.00 1.20-0.00-0.00-0.00-0.00
 1.13-0.00-0.00-0.00-0.00-0.00-0.00-0.00 1.16-0.00-0.00-0.00-0.00 1.37-0.00 1.19
-0.00-0.00 1.33 1.24-0.00 1.30-0.00 1.36-0.00-0.00 1.32-0.00 1.36-0.00-0.00 1.34
-0.00-0.00 1.20-0.00-0.00-0.00-0.00 1.21
```

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 700. | 700. | 700. | 700. | 700. | 700. | 700. | 424. | GORINT |
| 700. | 700. | 700. | 111. | 700. | 700. | 700. | 700. | |
| 727. | 700. | 700. | 700. | 700. | 700. | 700. | 700. | |
| 601. | 700. | 700. | 700. | 700. | 700. | 700. | 841. | |
| 700. | 700. | 438. | 120. | 700. | 700. | 700. | 700. | |
| 700. | 700. | 264. | 700. | 681. | 700. | 700. | 516. | |
| 700. | 700. | 255. | 700. | 700. | 700. | 700. | 306. | |

SAMPLE COMPANY DECISION DECK

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2. | -0. | -0. | 400000. | -0. | -0. | 50000. | -0.00 | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| 13. | 20. | 26. | 29. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | Decisions for |
| -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | Company One. |
| -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | |
| 36. | 56. | -0. | -0. | -0. | -0. | -0. | -0. | |
| 8. | 12. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| 2. | 10000. | -0. | -0. | -0. | -0. | -0. | -0.00 | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| 10. | 9. | 14. | 18. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | Decisions for |
| -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | Company Two. |
| -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | |
| 25. | 35. | -0. | -0. | -0. | -0. | -0. | -0. | |
| 4. | 8. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| 2. | -0. | -0. | 200000. | -0. | -0. | 200000. | -0.00 | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| 24. | 42. | 52. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | Decisions for |
| -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | Company Three. |
| -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | |
| 5. | 17. | 32. | -0. | -0. | -0. | -0. | -0. | |
| 8. | 6. | 6. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| 2. | -0. | -0. | -0. | 10000. | -0. | -0. | -0.00 | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| 7. | 31. | 41. | 50. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | Decisions for |
| -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | Company Four. |
| -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | |
| 38. | 45. | 51. | -0. | -0. | -0. | -0. | -0. | |
| 10. | 4. | 12. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| 3. | -0. | -0. | -0. | -0. | -0. | -0. | -0.00 | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| 19. | 34. | 37. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | Decisions for |
| -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | Company Five. |
| -0 | -0 | -0 | -0 | -0 | -0 | -0 | -0 | |
| 8. | 12. | 40. | 43. | 48. | 30. | -0. | -0. | |
| 8. | 20. | 8. | 8. | 6. | 4. | -0. | -0. | |
| 30. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |
| -0. | -0. | -0. | -0. | -0. | -0. | -0. | -0. | |

# APPENDIX E
## Formula Derivations

## Derivation of the Equation for the Decline Curve

The derivation of the decline curve is begun by starting with the equation for the slope of a curve:

$$D = \frac{-dq/dt}{q}$$

Where:

$D$ = the slope of the curve.

Rearranging the equation gives:

$$-D\,dt = \frac{dq}{q}\,.$$

Integrating the equation above within the limits of $t = 0$ to $t = t$, and $q = q_0$ to $q = q_t$:

$$-Dt\Big|_0^t = \ln q\Big|_{q_0}^{q_t}$$

which is:

$$-Dt = \ln q_t - \ln q_0 = \ln \frac{q_t}{q_0}\,.$$

When the exponential of both sides of the equation is taken, the result is:

$$\frac{q_t}{q_0} = e^{-Dt}\,.$$

Rearranging this equation provides the equation desired:

$$q_t = q_0\, e^{-Dt}\,.$$

The Derivation of the Equation to Calculate Initial Flow Rate

The derivation of the equation to calculate the initial flow rate when the recoverable reserves and the decline curve are given, begins with the equation for the decline curve which is:

$$q_t = q_0 e^{-Dt} .$$

If a low limit for $q_t$ is picked so that:

$$q_{(low\ limit)} = q_0 \text{ X FACTOR}$$

Where:

FACTOR = some small fraction.

Solving for $q_t$ at the low limit gives:

$$q_0 \text{ FACTOR} = q_0 e^{-Dt}$$

and by dividing both sides by $q_0$ provides:

$$\text{FACTOR} = e^{-Dt} .$$

The next step is to solve for t at the low limit which is:

$$t = \ln \text{FACTOR}/-D .$$

The reserves in the reservoir are equal to:

$$\text{Reserves} = \int_0^t q_0 e^{-Dt}$$

Where:

t = the time at the low limit.

Integrating and substituting the value obtained for t results in:

$$\text{Reserves} = \frac{q_0}{-D} e^{\ln \text{FACTOR}} + \frac{q_0}{D}$$

$$= \frac{q_0}{D} (1. - \text{FACTOR}) .$$

Solving for $q_0$ gives:

$$q_0 = \frac{(\text{Reserves})\ (D)}{(1. - \text{FACTOR})}$$